# 中国古生物誌

总号第151冊　　新丙种第19号

中国科学院 地质古生物研究所<br>古脊椎动物与古人类研究所 編輯


# 中国的假鰐類

楊鍾健著

科学出版社

## “中国的假鳄类”勘誤表

## (Errata)

| 頁 page | 行 line | 誤 for | 正 read |
|---|---|---|---|
| 6 | 3 from bottom | , Unless…noticed, all | , unless…noticed. All |
| 12 | 2 from bottom | …groove in for… | …groove is for… |
| 34 | 3 from bottom | The pubis missing… | The pubis is missing… |
| 94 | 3 from bottom | Chang | Chanig |
| 184 | 9 from bottom | *Sinkiangensis* | *sinkiangensis)* |
| | 4 from bottom | Yoong, C. C. 1963 | Young, C. C. and Yeh, H. K., 1963 |
| | 3 from bottom | Shihhatze | Shihhetze |
| | 2 from bottom | Ehemayin…pruia… | Ehrmayio…pareia… |
| | 1 from bottom | sanrian bearing…Hounan | saurian-bearing…Honan |
| 190 | 14 from top | Sclcromochloidae | Scleromochlidae |
| | 15 from top | Scleromochlidae etc. | etc. |
| 197 | 1 from bottom | , Uoless…noticed, all | , uoless…noticed. All |
| | 18 from bottom | …groove in for… | …groove is for… |
| 199 | 19 from top | The pubis missing… | The pubis is missing… |

# 中國古生物誌

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# 中 国 的 假 鰐 类

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（中国科学院古脊椎动物与古人类研究所）

插图 64　图版 I—X　插表 27

中国科学院 地质古生物研究所 / 古脊椎动物与古人类研究所 編輯

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## 內 容 簡 介

本书研究的材料均来自山西的武乡、榆社、宁武、鄜乐和兴县等地的三迭紀地层。該地区的假鳄类材料十分丰富，是中国肯氏兽动物羣重要組成分子之一。本书共描述了三个新属、四个新种，归于假鳄类的三个不同超科。其中以山西山西鳄一种的材料最为丰富。

作者用絕大部分篇幅詳細地描述了四个新种的骨骼形态，在此基础上，作者对中国肯氏兽动物羣的組成、中国假鳄类的研究历史、中国肯氏兽动物羣与世界其他地区同类动物羣的比較、假鳄类的分类与輻射、假鳄类的起源、假鳄类与恐龙类和哺乳类的系統关系以及假鳄类病态与生态等理論問題作了探討与回顾，并提出若干新的見解。

作者指出，通过假鳄类的研究，进一步証明以前所确定的中国肯氏兽动物羣的地质年代(早三迭世晚期至中三迭世早期)是正确的。本书同已出版之"中国的肯氏兽类"一书可視为姐妹篇，它們研究的对象虽然不同，然在許多方面却是互相补充、互相印証的。

假鳄类化石虽然在世界上分布很广，但至今研究得还很不够，因此，本书的出版其意义是十分重大的。另一方面，本书的出版对于研究其他爬行类和哺乳类的系統关系以及三迭紀陆相地层划分等問題也具有重要的参考价值。

本书可供古生物学、地质学、生物学工作者及有关专业的教学人員参考。


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# 中国的假鳄类

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四年脑汁絞尽，五种古鳄写完。远古兴亡从头看，初龙系譜可观。亿万年前事迹，初步形于毫端。断牙残骨說难全，提高有待后贤。

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# 中 国 的 假 鳄 类*

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## 緒 言

古脊椎动物与古人类研究所1955—1956年的野外工作中，后来1959年的全国地层会議在山西的工作中，以及1960年古脊椎动物与古人类研究所的研究生野外实习工作中，分别在山西东南武乡、榆社和山西西北宁武、靜乐和兴县等地采获了大量的脊椎动物化石。关于这些发見，已有一些初步和正式报导（楊，1957A，1957B，1957C，1958，1959A，1959B；楊、孙、叶、胡，1959 D；楊、孙、王，1959C；叶 1958；孙，1963）。孙艾璘最近发表了关于这一区域肯氏兽的专著，包括了以上区域的大多数材料。本文将研究同一地区的假鳄类遺存，其中很多类是和肯氏兽共生的。

本文所研究的主要材料来自山西东南武乡楼則峪西北的西什凹。野外号为56173。这一地点，不但堆积有大量的骨化石，而且化石的种类也多，是山西三迭紀化石属种最多的一个地点。其中絕大多数为山西山西鳄一种。象表1—3所显示的（外文，119—121頁），仅这一个地点有个体三十三个以上，此乃根据保存最多的股骨推算。考虑到骨骼零散情况，实际应比此还多一些。从56173以外其他地点，仅在武乡、榆社范围內，至少有九个个体（表2）。山西西北各地的地点，一共有五个个体，共加起来为四十七个个体，比肯氏兽的两属五种加起来的个体还多（照孙的估計为四十五）。

除了共生的肯氏兽科以外，同时找到的其他門类化石都比較少。56173地点以及其他少数地点有若干两栖类的大头龙类和前稜蜥等化石三种，此外还有三种其他假鳄类。除了大头龙和其他化石以外，所有假鳄类的研究，均包括在本文中。

虽然所掌握的材料十分丰富，但在研究中，还存在一些困难，不易克服。第一，如文所示，多数材料零星分散，保存欠佳，只有例外的少数标本可断定为确实归于一个个体；因此所有的装架都是綜合性的，由不同的个体安装，因之是带有假設性的。第二，关于这一門类化石，目下在国外近若干年来，进行的研究非常之少，只有少数刊物有所发表。参考文献上，也存在一定困难；因此，这一工作只能在有限的参考书和几乎沒有对比材料的基础上进行的。

尽管如此，但由于标本十分丰富，而且多具有很特殊的特性，所以还可能得出相当可靠、有的十分可靠的結論。

在本文各章中，将首先对材料加以系統的叙述。本文主要內容，当然为这一部分。叙述方法按照門类而不計其存在的地点。最后就地层上、生物上以及有关方面，加以总結。

所有材料的修理，无論是武乡、榆社的，还是宁武和兴县的，都是十分繁重的。仅从56173一个地点，就采了两吨以上的材料，有些化石，比周圍石头还軟，需要小心地修理。但尽管如此，一些化石的损伤和野外保存关系的錯乱，是难以避免的。修理工作，系在本所修理室主任技工陈春亭領导下进行，时間主要为1957—1959年，以后也陆續补修了一些。山西山西鳄的想象模型，系本所技佐王存义所作，我只加以必要的改正。几个头骨和骨架的装架由本所技工苏有玲和李功卓进行。所附照象和插图乃本所王哲夫、胡惠清等所作。在工作进程中王剡曾就文稿的准备和抄写等工作，加以协助。对以上所指出的同志和尚未指出而在工作中予以协助的同志，特别是1955—1960等年中負实际工作的野外工作同志，致以最誠恳的謝意。沒有他們的合作，这一工作不可能顺利地进行。

* 全稿于1963年7月2日完成。

在国外方面，作者对德国秋乘根的許耐教授，在加納的胡格士博士和在美国柏克利的华萊士博士，謹致誠恳的謝意。他們有的供給参考资料，有的介紹了有关文献。

杨鍾健 1963，3，29

# 一　般　叙　述

## 1. 所掌握的材料

A. 武乡楼則峪西什凹(野外地点号 56173)材料。

这一地点是本所野外工作队于 1956 年发見的。根据野外观察,是在二馬营羣中的第四骨化石层，呈菱状或袋状堆积。岩石性质为富含結核,由淡灰以至深紫色砂泥岩組成。 两吨以上的含化石岩石曾加以发掘运进研究室。化石很多,以前我們曾把这个堆积叫作化石角砾岩层(参看图版 I)。除了为了保存于陈列館計而保存下来一些大、中块以外,所有材料均加以修理。由于化石堆积得很凌乱,彼此关系不清,因而連一个骨架都不能确定为是同一个体的。表 1 表示从 56173 地点所采获的山西山西鳄的材料，包括可以观察到的一些成块的大标本(見表 1, 頁 111)。

从表 1 中可以估計,只 56173 这一地点,約有三十三个以上的个体,此数主要根据股骨的数目而求得。由于多数化石,特别是头部部分多分散而不属于一个体,很可能实际数目比这个还要多些。

除了山西山西鳄这一特大假鳄类以外,其他化石比較少,且一般保存不佳,計为:大头龙，楊氏副肯氏兽和三种其他假鳄类。在此包括于本文中为黑峪口山西鳄、稜脊汾河鳄和择义王氏鳄。 这些化石的詳細材料单分别見于各种的叙述中。至于楊氏副肯氏兽則見于孙艾璘（1963）的著作中，而大头龙則待以后再行研究[1]。

B. 56173 地点以外,武乡、榆社区域的山西山西鳄材料。

在武乡、榆社区域以外至少还有十个地点含有山西山西鳄。因为沒有在任何一地点,做过象 56173 地点那样大規模的发掘,所以所有的化石,多数都是很破碎的。据野外工作人員报告，有一些只是从地面检得的材料。但是无論如何还把它們包括在內,为的是表示出这种动物的分布概况。 在这些地点一般都和肯氏兽共生(見表 2, 頁 113)。

C. 山西西北部宁武、靜乐和兴县的山西山西鳄材料。

除了武乡、榆社以外,山西山西鳄还在山西西北几个地方发見。在宁武发見的有两个地点，在靜乐有一个地点。 1960 年本所人員在野外实地工作时，在兴县黑峪口又发見了一个地点，一共有四个地点（表 3, 頁 113)。

虽然山西山西鳄的遺存很多,但是只有在上表 NWC, E.（V.2501）一地点所获得的材料可以当作全属于一个个体,无何疑問。象以上所指出的,56173 这一地点的丰富化石十分凌乱，不易判断某些化石是否确实属于一个个体。所以以下的再造,有些地方是需要加以保留的。

另外一方面,全部材料包括从幼体到成年以至老年个体的差异等。因此有可能就骨骼各部分,在这方面加以仔細的研究。

56173 地点以外的其他地点的假鳄类化石材料，分别列于黑峪口山西鳄，稜脊汾河鳄和择义王氏鳄项下,此地不再单列。

## 2. 关　于　地　层

关于含脊椎动物化石的地层,在以前各临时报告中,以及一些正式的报告中,特别是孙艾璘(1963)的著作中,均有所叙述。因为沒有什么新的見解可以补充,所以在此不打算过多的討論。

所要特别指出的就是在武乡、宁武等地沒有做大規模发掘以前,武乡、宁武一带的二迭紀、三迭紀地层,一般叫做石千峯組和延长羣。当著者最初研究武乡、榆社的二齿兽化石时(楊，1937A)，沒有企图就地层方面作出精确的对比，但当时曾指出含中国肯氏兽的层位为上三迭統，此乃根据步龙（R. Broom，1932）的

1) 本书付印时,大头龙研究臉文已发表,見楊鍾健 1963: 山西中国肯氏兽动物羣的迷齿类,古脊椎动物与古人类,7 卷 4 期,頁 331—336。

三迭紀划分方法，以南非的犬頜兽当作上三迭統的下部，不包括眞正归于上三迭統上部的瑞替克层。自此以后，多数作者把犬頜兽一层当作中三迭統底或下三迭統的上部，因此中国肯氏兽所属地层的年代也要相应地向下推一些。因为我們的动物羣和南非的十分接近，至少在一般对比上問題不大。

近来在山西关于古生物和地层等方面的研究工作証实了这一論点，即在武乡和宁武等地的含肯氏兽和假鳄类的骨化石层，既不属于老的石千峯組也不属于新的延长羣，而是一个新的羣，叫作二馬营羣。在武乡区域，为我們研究的多数化石的产地，二馬营羣厚約150米，含有五个不同的可以鉴定的骨化石层（楊，1959；孙，1963），所有我們这里描述的假鳄类位于这个羣的較中部，即第三到第四层，而上下均沒有假鳄类化石。詳細情况将在結論中論及（表17，頁183），在目下应当着重指出的，至少从山西山西鳄和其他假鳄类来判断，沒有划分一层以上的化石带的必要，象肯氏兽所指出的那样（中国肯氏兽較低，副肯氏兽較高）。

从动物方面諦，在此所描述的大量山西山西鳄代表一很具特性而清楚的种，尽管个体間的变化是相当的大，在地理分布上也很广，仅次于肯氏兽，但代表山西三迭紀紅层最能作地层对比的有用化石之一。其他假鳄类，虽然材料較少；但也具有一定的地层意义。

## 3. 研 究 过 程

在开始研究时，只打算研究56173这一地点和其他一些地点的山西山西鳄。但在进行过程中，增加了其他三种假鳄类。这些假鳄类十分有兴趣而又十分重要，于是乃决定把所有从山西发見的假鳄类作为整体，一起研究。以期能够得到更完整的概念和結論。山西的假鳄类到目下为止，在本文中所記述的計为三属四种分别归于三个超科。其地层和地理分布也因之更明确。到目前为止，在山西以外还沒有发見可与山西对比的任何假鳄类化石。只有加斯馬吐龙除外。这一属的一种袁氏加斯馬吐龙，以前記述中，以为見于5537地点，今重加研究，发現其与眞正的袁氏加斯馬吐龙还有区别，因之改定为一新种名叫最后加斯馬吐龙。

关于假鳄类的文献，特别是有关引鳄的文献是不十分多的。在研究过程中除尽量应用能掌有的有关文献外，不得不主要限制在标本本身的描述上，特别是头后骨骼部分。很有可能一些重要的文章被疏忽了。

在研究过程中，曾得一些消息，在世界其他地方的三迭紀地层中也做了不少发掘和正在进行的研究工作。其中一些已包括在本文的比較中，也有可能有些尚未能加入。这个事实也説明三迭紀动物羣在全世界分布的广泛性和重要性。

文中所有表均見外文部分中，而插图则在中文中。

# 动 物 羣 的 系 統 描 述

## 目：槽齿类（Thecodontia）Owen 1859

## 亚目：假鳄类（Pseudosuchia）Zittel 1889

## 超科：原鳄科（Proterosuchia）Broom 1911

## 科：山西鳄科（Shansisuchidae）新科

以以下所描述的山西鳄作为本科的典型属。

## 属：山西鳄（*Shansisuchus*）新属

**特性**：体格相当的大，和这一超科中引鳄科的引鳄在許多方面相近似，但是具有两眼前孔。第二眼前孔的前部扩至鼻孔以下，后者位于头的尖端。牙齿为次槽齿式。下顎前部接合处加厚，具有侧孔。除第一脊椎外，脊椎无間椎存在的痕迹。四肢骨比起引鳄較为瘦小。

### 山西山西鳄（*Shansisuchus shansisuchus*）新种*

**材料**：如上所述，本种的材料十分丰富。虽然宁武发现的头骨（V.2501）和一些脊椎骨及四肢骨共同发見，保存也較好，但我們觉得把武乡 56173 地点的一个头顶骨盖（V.2503）当作标本的正型标本比較合适，因为几乎百分之九十的材料都是来自这一地点。这一地点的其他头顶骨盖（V.2504—V.2511）以及武乡、榆社的大多数其他地点，和靜乐、宁武及兴县的較为破碎的标本（宁武和兴县除外）（V.2593, V.2512, V.2450, V.2502, V.2513）是当作副型和列入此种的标本。本文所研究的材料包括表 1—3 中所列的标本。

**层位与产地**：下三迭統上部至中三迭統下部。山西武乡楼則峪西什凹及其他地点（見表 1—3）。

**特征**：体格小于非洲引鳄。头骨較狭长。上顳顬孔向上开口，侧面几看不見。具两眼前孔。下顳顬孔特大，大于眼孔，作圓角方状。前上顎骨以中部向后上突起分开鼻孔和第二眼前孔。上顎骨外平內凸。上部突起較靠后，分开第一和第二眼前孔，下緣微凸。顴骨較薄。鼻骨狭长和額骨接触作交叉状。鼻孔小，位于第二眼前孔的前端。第二眼前孔小于第一眼前孔，前者前部位于鼻孔下部。眼孔大，呈椭圆状，几全朝侧面。顶骨无顶骨孔，但在原处有一凸起。額骨未伸至眼孔边緣。間顶骨存在，向后成一突起。后額骨比前額骨小，和眶后骨作关节状接触。間顶骨下的突起显著，枕骨孔比較小，宽而低。下顎骨頎大，前端交接处特为強厚。具有齿骨孔。牙齿尖銳，为次槽齿型，前后緣均有鋸齿状結构，大小交錯。牙数：上 14，下 14—16。脊椎数：頸 10、背 25、荐 2、尾 40＋。頸脊椎特短，輕度双凹、环椎具有間椎体，以后无此骨遺迹可見。背脊椎前者較粗大，腰部小而显出輕微双凹状。荐椎前一个大于后一个。尾脊椎中部特为收縮，并为微双凹或至双平。肩胛骨中部較收縮，末端扩大。烏喙骨頎大，烏喙骨孔外侧距边緣相当之近，而內側通边緣。肱骨两端均特扩大，三角稜較下伸。外髁孔消失，但在幼年标本尚有沟状遺痕。尺骨較短，稍短于肱骨。橈骨几与尺骨同长。荐骨之髋臼可能不完全縫合。腸骨板較薄，前端鈍而小，后端作柱状。坐骨与引鳄相似。恥骨孔較近边緣，作缺口状。股骨較直无"S"状弯曲。脛骨較細瘦，短于股骨。腓骨亦細小，但稍作"S"状弯曲。后肢稍长于前肢。距骨粗大，跟骨作方板状，与引鳄相似。手掌骨和足掌骨比較短宽，指和趾骨也短而宽，末指左右扁而尖。前后足骨說明全掌几全着地，行动迟緩。

## 正型头骨与其他头盖骨的描述

**正型头骨（V.2503）**：这是 56173 地点保存最好的一个头骨，代表一个成年个体。它的保存部分为自鼻

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* 山西山西鳄这一名詞，最初见于杨鍾健 1959 B 的一篇一般性的报告中，未列特征，应以此为准。

骨前端起(稍有损伤)到顶骨的后突起。虽然有些骨的尖端或边緣，稍有不全，如鼻骨前部，顶骨突起后部，右側的前和后額骨等，而其大多数的縫合綫，却清楚地保存。

腹侧和两側保存欠佳，且附粘了一些不能确切鉴定的骨头。但鼻骨前部的側面部，却还保存完好。

这一头盖骨很为狭长。令人感到較为瘦小。前端的中綫，特別是鼻骨的中綫部分，接触很松，表示这一标本代表的动物刚过成年期不久。从前到后保存的长度为 420 毫米，原长可能約为 440 毫米。鼻骨所占的长度，清楚地比头骨所有的长度为长。头骨最宽处位于距眼孔前不远处，在前額骨側。

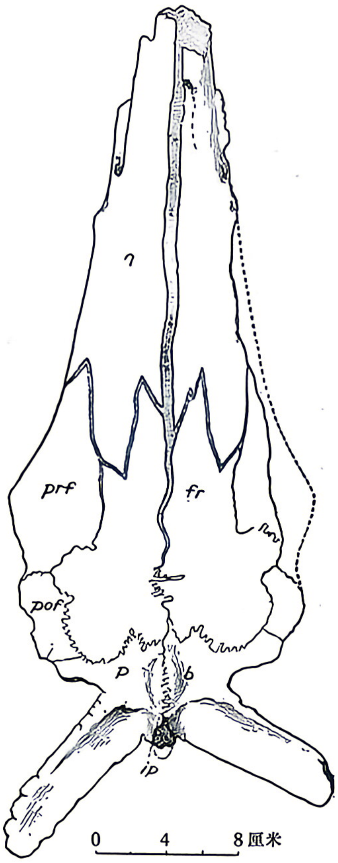


图 1 山西山西鳄头骨，新属新种正型标本，自上視。原大四分之一。

Fig. 1 *Shansisuchus shansisuchus* gen. et sp. nov. V.2503. Skull roof from the dorsal view. 1/4 nat. size. Abbreviations figs. 1—6. b. boss; bo. basiocipital; bs. basisphenoid; ex. exoccipital; fr. foramen magnum; fr. frontal; ip. interparietal; l. lacrymal; op. opisthoticum; n. nasal; p. parietal; po. postorbital; pof. postfrontal; prf. prefrontal; so. supraoccipital; sI. supratemporal opening; sII. infratempral opening.

注：所有在插图和图版中的标本，如非另作声明，均来自 56173 地点，所有标本均保存于古脊椎动物与古人类研究所标本室。All the specimens illustrated in the text-figures and plates are from the locality 56173 (Hsishihwa, Lotzeyue, Wulisiang Shansi). Unless otherwise noticed, all are kept in the Museum of IVPP.

間顶骨与顶骨間的接触不清楚。 許耐(Huene, 1911)研究引鰐时并未当作另外一骨，而只是当作間顶骨延伸，但布林克(Brink, 1955)在研究同一种的另一新标本时，却認为間顶骨的确存在。在作者看来，觉得間顶骨的确存在，一如同一超科的加斯馬吐龙。 因为顶骨后部冲出部分以及两侧突起間似有縫合綫的痕迹，一如第一图所示。这一头骨后部的尖端，在这一标本有损伤，但在其他标本，保存較好(V.2505, V.2501)，作圓錐状。

**顶骨**：顶骨沒有顶骨孔。 但在原处有一清楚的小隆起部分（boss）。顶骨短而宽，两上顳顬孔的內側边緣部分保存很好。在顶骨后部，有一比較清楚的凸出脊稜，沿后突起上緣向后向两側伸出。

**額骨**：两額骨的中后部稍为凹平，两側有清楚的隆起稜。 由于前額骨和后額骨直接連接，而使額骨未能达于眼眶边緣（图左側表示很清楚，右側处破损）。沿額骨各处縫合綫都很清楚。前部中綫如鼻骨一样，还未愈合。額骨和前額骨及鼻骨以特別显著的鋸齿状綫相接触。但是額骨的边旁前伸的突起，比較低短。此与引鰐十分相似。

**后額骨**：和引鰐以及加斯馬吐龙一样，此一骨，很发育［但在伍加斯冠維亚（許耐，1960）和加尔貝尼亚（奥尔契夫，1958）两属还不十分清楚］。和其他邻近的骨的界限也十分明了。在正型标本，两側边緣均有损伤，但其輪廓在第一图表示的很清楚。 此为一窄长之骨，比前額骨为小。

**前額骨**：左側保存較好，只有边緣有些损坏，最宽处位眼眶的前部，在眼眶收縮处前不远处。由此处向前慢慢地变窄，最后成一尖状角插入鼻骨的側部。在这一部分，此骨稍微高出于額骨的平面。

**鼻骨**：鼻骨近于完全，只有前端和右边的側后部有些损坏。 第二眼前孔后部前的收縮，在正型标本，只有輕微的表現。 两鼻骨只中綫是直的，但未連接，似系在死后分开。前上顎骨的突起在鼻骨两側可以很清楚看出，其相当的沟，此以分开鼻孔和第二眼前孔。后者的边緣一部分在鼻骨上也可認出。在鼻骨側观，鼻骨后部和第二眼前孔可以看到。 在側面看出鼻孔向下的延伸部分，代表第二眼前孔后下边緣，十分清楚。

其他保存較好的头盖骨，可以补充正型标本之不足。兹分述如下：

**V.2506 头盖骨 (56173)**：这一头骨保存的部分为头骨后部和鼻骨的后部。鼻骨和头骨其他部分稍有錯位。但这头骨是 56173 地点唯一具有两側眶后骨在原来部位的标本。連眶后骨前突起和下突起都保存的很完好。由此我們可以得到上顳顬孔和眼眶的形状和特点(图 2，A)。

在这一标本中，間顶骨的形状和縫合綫比正型标本保存較好，但其后的伸延部分也已坏掉。顶骨的向两側伸的突起的尖端已破坏掉。和正型标本不同处在于这向两側伸的突起

根部靠下,具有突出加厚的部分。这在正型标本,至少不明显。头骨的收縮部分位于前額骨和后額骨間，但也距額骨外側还有 10 毫米。在左側此类縫合綫（位于收縮处,而介于两骨眞正接触之間）十之八九为一裂縫。两骨的接触和正型标本相同。关于鼻骨可記述的有限，左側的第二眼前孔后的鼻部向下延伸，一部保存。和額骨与前額骨接合处,当与正型标本相同,不过部位稍为錯开。

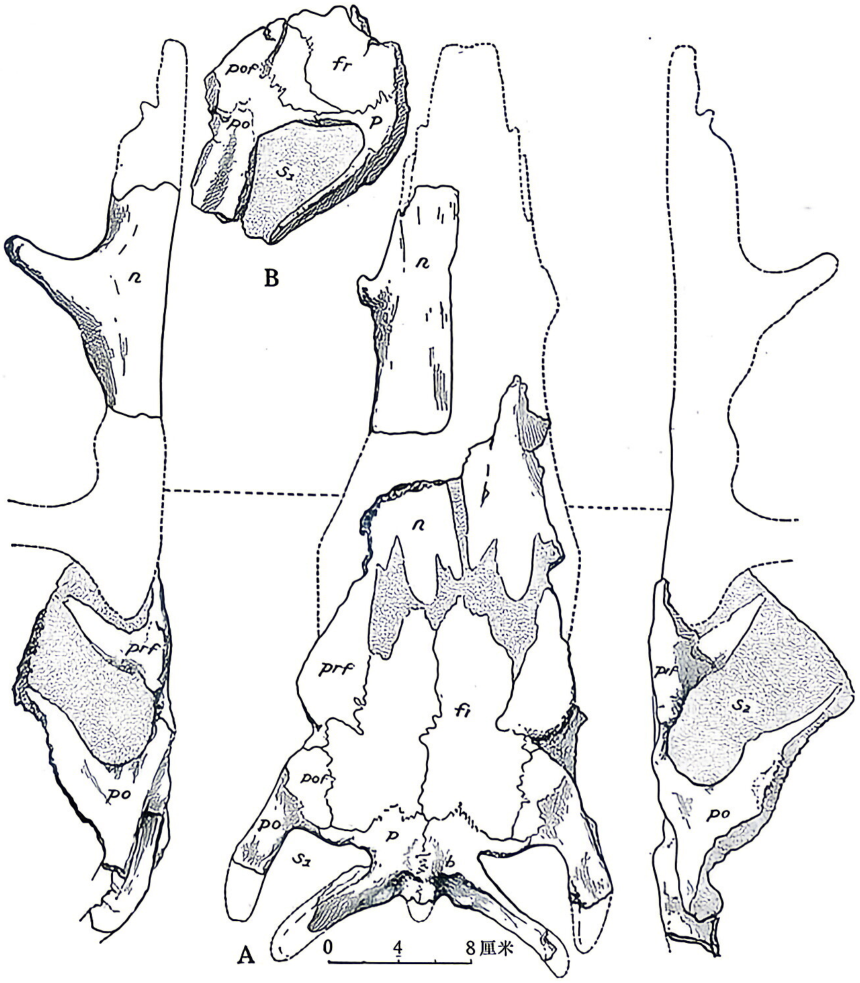


图 2　A. 山西山西鳄头盖骨

V. 2506. 背覌与腹覌。鼻骨破片,可能属于同一个体。这一标本,侧面保存較好。原大四分之一。

B.　同上

一左上顳顬孔及其附之骨,表示此孔的形状。原大四分之一。

Fig. 2 A. *Shansisuchus shansisuchus* gen. et sp. nov. V.2506 in dorsal and ventral views. The nasal fragment belongs probably to the same individaul. In this specimen the lateral part of the skull is tolerably preserved. 1/4 nat. size.

B. *Shansisuchus shansisuchus* gen. et sp. nov. The left supratemporal opening with the surrounding bones to show the shape of this opening. 1/4 nat. size.

**眶后骨**：在两側均保存很完好,且大体上仍在原来位置,只有两个后部的突起的尖端坏掉,而左边的下突起不完全。眶后骨是朝三个方向放射的骨,为分开上下顳顬孔,上顳顬孔和眼孔，下顳顬孔和眼孔的主要骨骼。和后額骨接触处厚而几呈直綫状,和头骨中綫成 45° 左右的角,显非普通的縫合接触,而为关节状,生时可能微有錯动。分开上顳顬孔和眼孔处很宽,上部有清楚的凹下面。由此向后向外延伸,成为上顳顬孔的外緣。在此桥状部上、中部也有微微的凹入处。下突起向前向下延伸。并且在眼眶上边下很近处,稍为加宽然后逐漸变成狭窄,成为和額骨上突起接連的一部分。

**V.2505 头盖骨**(56173 地点)(图 3)：此为一較未成年的个体。其保存情况，和正型标本差不多。但鼻骨的尖端与間顶骨部分保存較好。由于未成年，头上的不規則的沟(主要沿中綫方向)和骨面上的粗糙情形特別保存清楚。和正型标本比起来，在鼻骨向下伸出的后部，其收縮情况，較为显著。鼻骨和额骨連接处，有三个深凹，好象是生前受伤的痕迹。其他性质和正型标本相同。

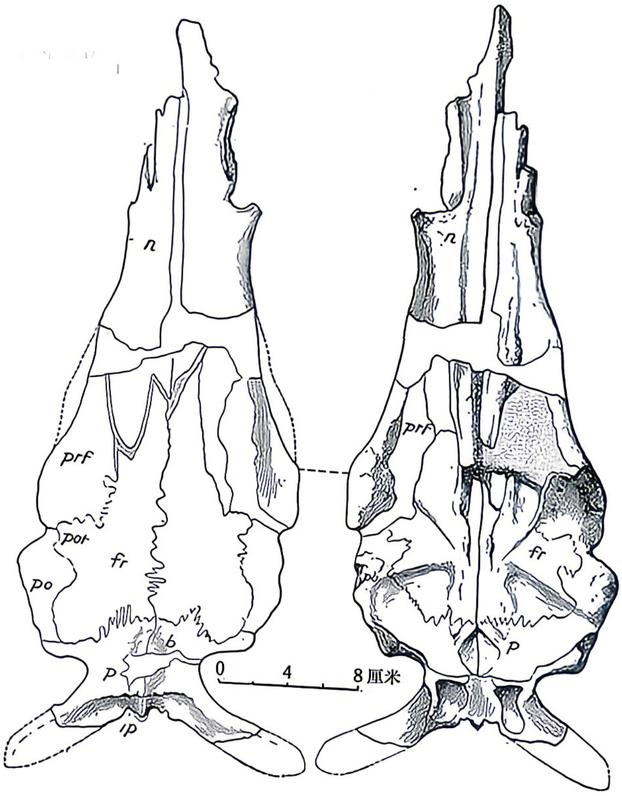


图 3　山西山西鰐，新属新种

V. 2505. 头盖骨背視与腹視。可能为一年幼个体。原大四分之一。

Fig. 3 *Shansisuchus shansisuchus* gen. et sp. nov. V.2505. Skull roof of probably a young individaul in dorsal and ventral views. 1/4 nat. size.

較有兴趣的是头盖骨的下部完全暴露。一般說来，下部的构造和引鰐(布林克，1955)非常相似。在我們的标本上，分开脑壳和間顶骨和顶骨后突起的横稜非常显著。凹下部分，相当于背面的隆起部分也很显著。卽在腹面也沒有頂骨孔的任何遺迹。在凹下部分的两侧，另有两个大的三角狀凹下部分，恰为背面凸起部分的另一面。在这一部分以前，有三个放射狀的很突出的稜脊。在前額骨向下伸出的突起，局部保存。在鼻骨部分有两前后直脊稜，后部較強，前部較弱。

**V.2504 头盖顶骨**(56173 地点)(图 4，A)：这个标本保存稍差，特别是鼻部。后眶骨的根部局部保存，特别是左側。就縫合綫看，代表一成年个体，比正型标本老一些。間顶骨后端缺失，头盖骨的腹面也露出，但不及 V. 2505 的完好，其一切构造和后者完全一样。

**V.2508 头盖骨**(56173 地点)(图 4，B)：未能完全証实这一头盖骨的鼻部确属于头骨后部，但十分可能。因为两部的骨的一般性质和粘着的岩石以及鼻骨后部和額骨前部接触狀况都說明可能为同一个体。无論如何，事实上两者有些錯位。这也代表一成年个体。所有縫合綫在多数情况下是不清楚的。但在头骨的形狀和各骨的构造方面，找不出和以上描述的标本有任何显著不同的地方。

**V. 2509, V. 2510 及 V. 2511 头骨顶盖**(56173 地点)(图 5，A)：V.2509 代表一头盖骨，从鼻骨后部到間顶骨，顶骨均保存。前額骨和后額骨只局部保存。顶骨中部的突起，以及額骨和顶骨等的縫合綫均可看

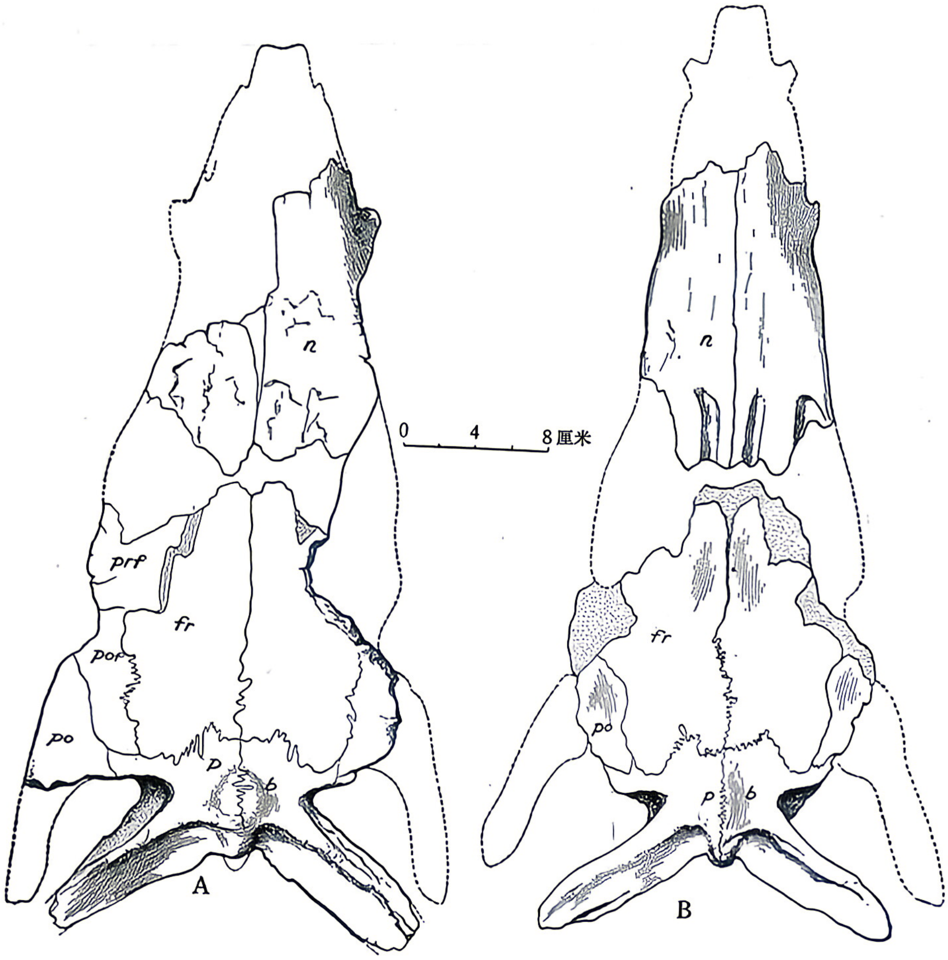


图 4　山西山西鳄，新属新种

A. V. 2504; B. V. 2508. 均背视。原大四分之一。

**Fig. 4** *Shansisuchus shansisuchus* gen. et sp. nov. A. V.2504; B. V. 2508. Both in dorsal views. 1/4 nat. size.

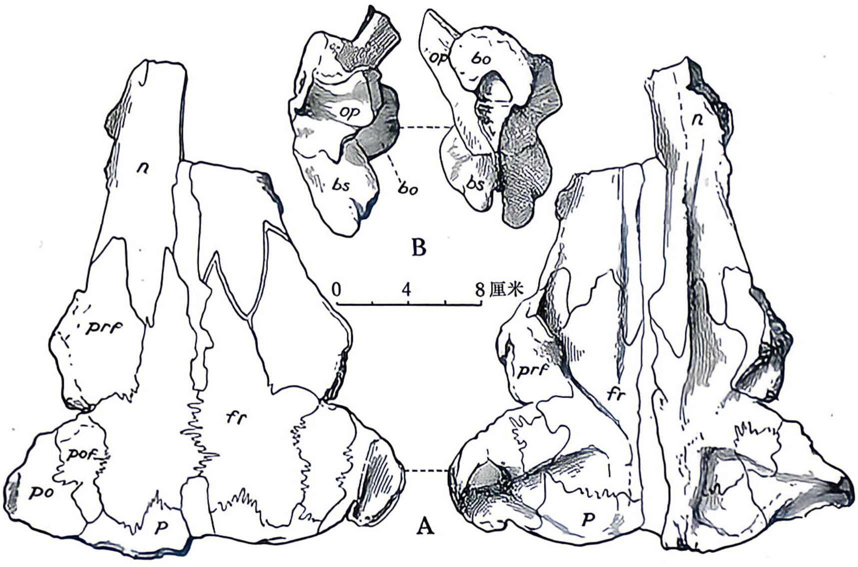


图 5　山西山西鳄，新属新种

A. 头盖骨背视与腹视。 V.2511; B. 头骨的枕骨部分。左侧与前侧。均为原大四分之一。

**Fig. 5** *Shansisuchus shansisuchus* gen. et sp. nov. A. skull roof in dorsal and ventral views. V.2511; B. occipital part of a skull in left side and anterior views. All 1/4 nat. size.

出。在各方面此一标本和前述者完全相同。

V. 2510 为一头盖骨具有額骨和与之接連的各骨部分。腹部也保存良好。

V.2511（图 5, A）保存的有鼻骨后部两前額骨和两頂骨。腹側也完好保存。

V. 2510 和 V. 2511 两标本在任何詳細构造上都和其他已述标本相同。两个均代表較成年个体。

**宁武二馬营孙家沟的头骨（V.2501）**：这是一保存很好的标本，除头骨外，还有头后骨骼若干，将在以后記述。头頂部本身只有額骨同四周相連接的骨保存。但这是我們所有材料中唯一标本。具有枕骨孔和与之相連的骨，以及基蝶骨保存。額骨前端和头骨的两边（特别是右侧）頗有损伤。由于許多縫合綫不清楚，而且骨也特別厚，表示系为一老年个体。未連接的左鼻骨虽然和头骨找不到眞正接合处，但十分可能即归于此头骨，而为一个体（图 6）。

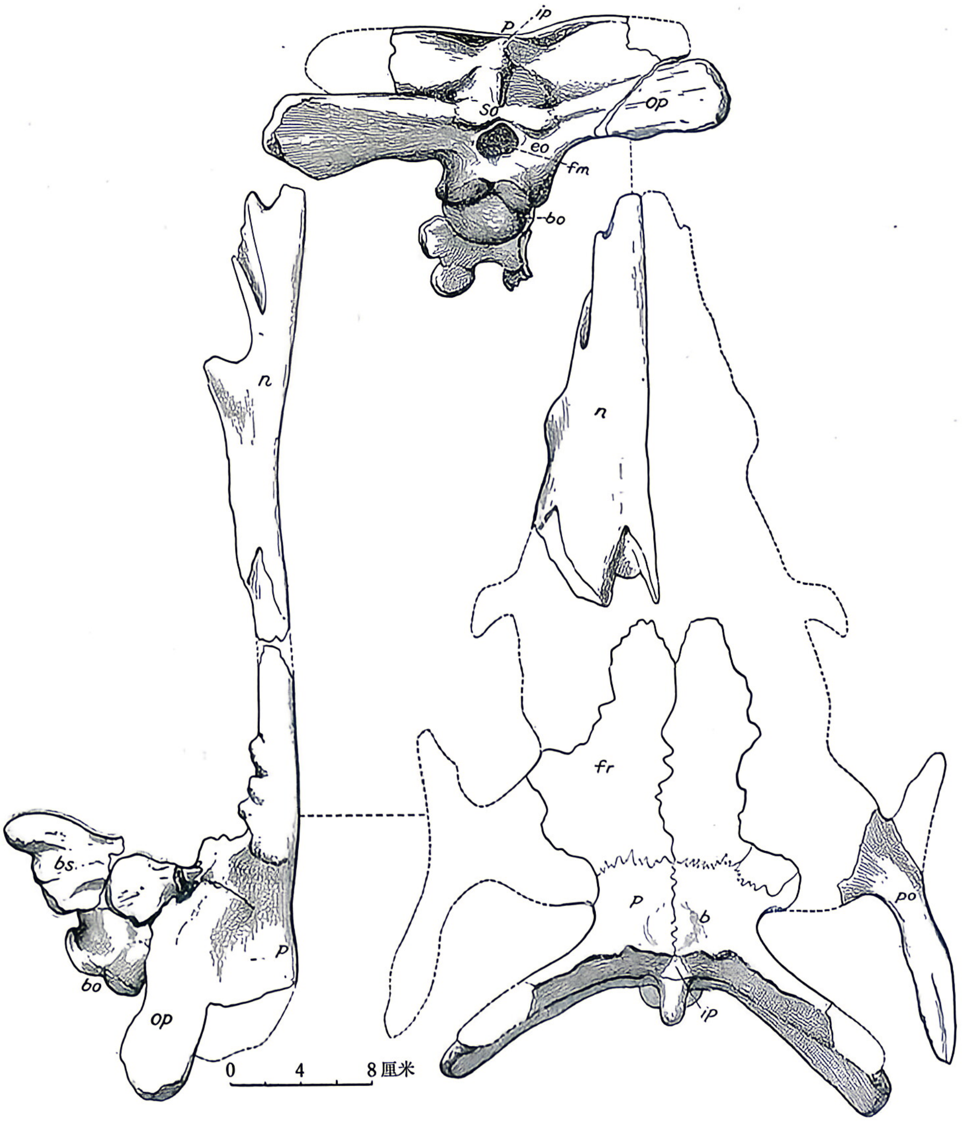


图 6 山西山西鱷，新属新种

V. 2501. 山西宁武二馬营、孙家沟。背視与左側視，及后側視。原大四分之一。

Fig. 6 *Shansisuchus shansisuchus* gen. et sp. nov. V.2501. Skull from Hutaikou, Tachang, Ningwu, Shansi (NWC E. D.) in dorsal, left side and occipital views. 1/4 nat. size.

从头骨背面看，可作以下一些观察，以补以前所記述头骨的不足。

間顶骨突起相当长，具一圓顶状末端。但其最尖端还是稍破，一如其他标本。顶骨突起处十分显著。但沒有中間低稜，也沒有正型标本的那末突出。顶骨和额骨間以及与前額骨(左側)縫合綫很清楚，但額骨、后顶骨和前額骨(右側)就不清楚。各骨彼此相对位置及构造和其他标本无突出的不同。顶骨后两突起末尖已損坏。两突起形成一較为圓曲的輪廓，和正型标本不大相同。顶骨后边脊稜十分显著，凸出于头骨的枕骨面。

右鼻骨近于完整，前端稍損坏，和額骨成交叉状接合，十分明显。第二眼前孔后的收縮和向下向前伸的突起也比較显著。为容收前上顎骨后突起的深沟非常明显。鼻孔全部显明地向上作隆起状，在腹側，那两个前后稜也特別清楚。所有这些情况和性质，說明此标本属于一較老年个体。

在头骨的后面观，显示了唯一枕髁面。枕髁面上部由顶骨的后突起和間顶骨組成，一如 *Vjushkovia*。但在我們的种，間顶骨后的突起特为显著。虽然顶骨的后两突起尖已損坏，但非常可能不能伸出于后耳骨（枕髁側骨）多远。間顶骨两側的凹入較为清晰，系由于上述的顶骨后突起的凸出之故。

在間顶骨下面，介于顶骨后突起之間，紧在上枕髁骨之上，有一向后伸出的突起很显著。这个突起的位置很低，以至不能当作是間顶骨突起之向下連續部分。其长为 29 毫米(从背側量)。这个突起的根部很低，正在上枕髁骨的上边，亦为 29 毫米，距枕骨孔只 14 毫米。其根部宽为 21 毫米，尖銳較圓鈍 13 毫米。此当然为一很发育的突起，其四周的縫合綫不清楚，只与間顶骨的除外。这只能当作一特殊发育，或者为顶骨的一部分(可能性較大)，或者上枕髁骨的一部分。以上构造也为布林克(1959，p. 143)所記述(关于加斯馬吐龙)。但在其文中描述的不清楚。所有已記述的引鳄头骨，以及与之相近的头骨，这一部分全未保存。非常可能在这一类动物中，顶骨的这一特殊的突起是存在的。毫无疑問，这个突起如布林克所指出，起着关节活动作用。

在这一突起的較低处，介于顶骨突起和后耳骨之間，有一清楚的后顳顬孔，在右側保存的較好。

上枕髁骨　造成枕髁孔的上边緣，但和其旁有关的縫合綫未能找出。但仔細观察，可能存在，至少和顶骨后突起以及后耳骨的，似可模糊辨認出来。其大致輪廓可能向外側展宽一些。

后耳骨(側枕骨)在两边均保存完好。好象这个骨只参与了枕髁孔的极少一部分。向末端輕微加宽，也很薄。另有一較显著的宽脊，开始于上髁骨的外側，向外伸展，然后消失于此骨之上。左后耳骨末端的上部和顶骨后突起接触的痕迹較为明显。位于距末端的总长三分之一的地方，在腹側近根部的沟深而显著。

枕髁骨关节很碩大，向后伸出很显著，近根部有明显的收縮。从后面看，其輪廓为宽圓的三角状，上緣有一宽的沟。从腹側看，枕后髁关节，可以分作三部分。在中部一横的小沟介以中間小沟，亦即为骨之最低部分。在关节的边緣，特別在下部非常光滑，代表眞正的关节部分。

枕骨孔比較小，横宽为 30 毫米，高为 15 毫米。

头骨側面所表示的为脑壳側面和額骨，前額骨、顶骨、后耳骨、枕髁骨以及基蝶骨等的一部分多少露出。有一些神經孔和頸动脉孔也露出，如图 6 所示。

总的来說，宁武的头骨，在一般性质上和引鳄很相近。但其有由顶骨构成的向后伸的角状突起，位于間顶骨之下。另一特点是沒有顶骨孔。毫无疑問，V.2501 标本和以前所描述的属于同一种。只是年龄較大而已。

## 属于头骨的零散骨骼描述

在我們的材料中，有一大部分属于头骨的零碎骨骼，其中大多数为 56173 地点的标本，也有些来自其他地点的。这些骨骼很为重要，因为可以借以知道头骨的构造，特別是有关各孔的数目和位置方面。在以下就这些骨骼加以敍述，在以上已提到过的，只简单提一下，不再詳敍。

除了以上从 56173 所描述的八个头骨和宁武孙家沟一头盖骨外，只有 56173 还有一个标本，其顶骨、額骨和前額骨尙彼此連接。此外还有許多的单个的顶骨碎块，特別是向后側突起。另外許多額骨和前額骨的碎块。这些材料沒有很显著的构造上的区别，但是有些表示不同的年龄。

有一几乎完全保存的左后眶骨，值得特别加以記述(图 7，A)。此骨代表一成年个体，比 V. 2506 头上那

一后眶骨还要硕大一些。和后额骨接触处又宽又厚。造成眼眶上后部，上颞顳孔外緣，和下顳顳孔上前部的边緣，十分明显，其輪廓都可以看出。比起V. 2506标本来，接近和后額骨接触的底部，和下突起根部的凹入面，比較不清楚。或者由于年老个体的原故。至于后突起末端的凹入面，却十分显著。和额骨上部接触处，有一較宽而粗的面，从內側看，下突起显得很粗厚。在和后額骨接触的下边有一很深的凹入。

另外一个标本具有后額骨和后眶骨的一部分以及右頂骨(图2，B)。除了V. 2501头骨以外，这是唯一标本，保存有上顳顳孔的完全形状，而且更为完好。上顳顳孔，其外边几和头骨的中軸平行，內側的角为銳角。后外角也成銳角但比內角較大。

零散的枕髁骨和基蝶骨很多。但都很破碎，且有的有些錯位，所以除以前关于V. 2501已描述的以外很少有什么新的可增加。图7B表示一枕髁的前視和側視，大体和V. 2501的相同，不过較小，代表一較年幼的个体。也有一些基蝶骨是幼年的，另外还有些零散的后耳骨，也包括一些年幼的个体在內。

除了連带与头盖骨已描述的鼻骨外，零散的鼻骨，相当之多。但相当破碎，左右往往分开，两端一般地缺失。有許多是未成长的鼻骨，尽管如此，一些标本具有前上顎骨后突起沟，和第一眼前孔为鼻骨所形成部分

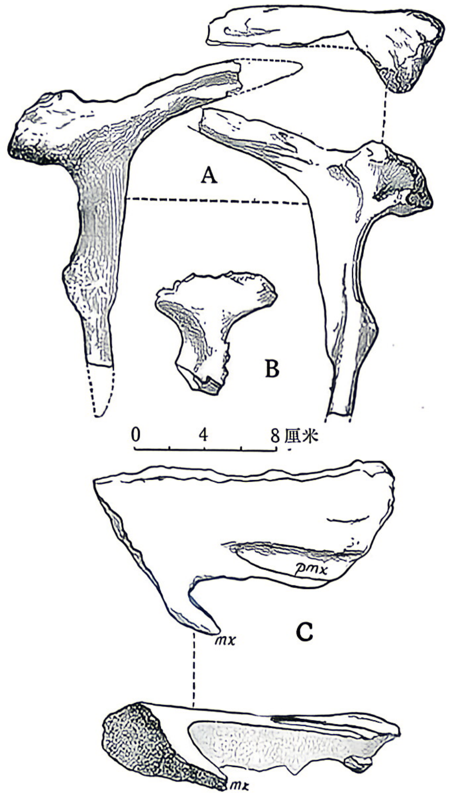


图7 山西山西鰐，新属新种

A. 左眶后骨，內外視；B. 右泪骨外視；C. 右鼻骨。詳见正文。均原大四分之一。

Fig. 7 *Shansisuchus shansisuchus* gen. et sp. nov. A. left postorbital in outer inner and upper views; B. right lacrymal in outer view; C. fragment of right nasal showing the posterior downwards extending process for separating the first and the second preorbital openings. This process is in connection with the upper process of the maxilla, mx. The groove in for inserting the posterior process of the premaxilla, pmx. All 1/4 nat. size.

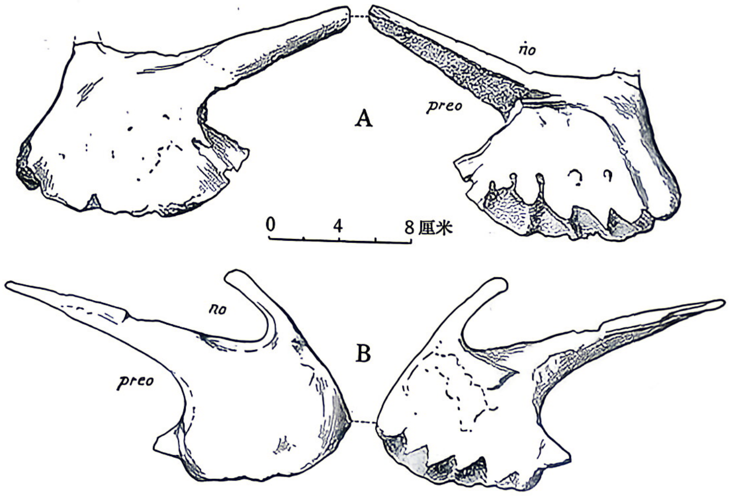


图8 山西山西鰐，新属新种

A. 左；B. 右前顎骨，外視与內視。注意前緣的区别。均原大四分之一。

Fig. 8 *Shansisuchus shansisuchus* gen. et sp. nov. A. left and B. right premaxilla in lateral and median views. Notice the difference of the anterior border. 1/4 nat. size. no. nasal opening; preo, second preorbital opening.

的輪廓，有些标本，其向下延伸的相当低。图7C，为一老年的右鼻骨。这一标本的容受前上顎骨后突起的沟相当靠后，而且向下延伸，以构成眼前孔的部分，比較为低。所有标本除了表示年龄不同外，沒有什么构造上的特殊区别。

泪骨保存很差，而且相当有疑問，难以确定。在一头盖骨上，一对泪骨还和额骨与邻近的骨相連接較为可靠。此外有一右泪骨(图7，B)。泪骨的外形和*Stagonolepis*属有些相象。中部較收縮，向前延伸很长。看来泪骨的位置在前额骨下突起的較前部。正如布林克所描述的加斯馬吐龙那样。

**前上顎骨**：沒有一个前上顎骨和头骨关連在一起发見的。所以和头骨的位置关系是可疑的。但为了作成至少是綜合性的头骨复原，我們用了一些前上顎骨，其选择主要是比保存状況，

比大小，比所附的岩性等等。尽管如此，还是尝試性质的。

虽然前上颚骨不少，但只有极少数是完全的或者近于完全的。較好的标本見图 8 和图 9，包括从幼到老的代表型。最完全的标本（图 8A，B；图 9，A）使人毫不怀疑，我們所研究的新假鳄类的头前部，具有两个孔，其一为鼻孔，前上边緣就是插入鼻中边沟的，短的前边上的前上顎骨向后突起。另外較靠后靠下的一孔，其前部和鼻孔分界处为前上顎骨向后突起所构成。这个孔就是第二眼前孔，那向后突起的和鼻骨相近，在后者

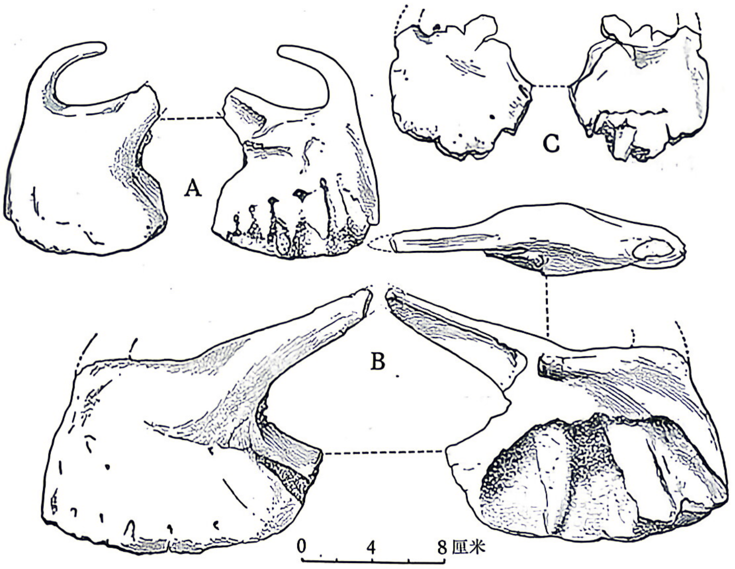


图 9　山西山西鳄，新属新种

A—C. 三左前颚骨，外视与内視，年龄各不同。均原大四分之一。

Fig. 9　*Shansisuchus shansiuchus* gen. et sp. nov. A—C. three left premaxillaries of various ages in lateral and inner views. 1/4 nat. size.

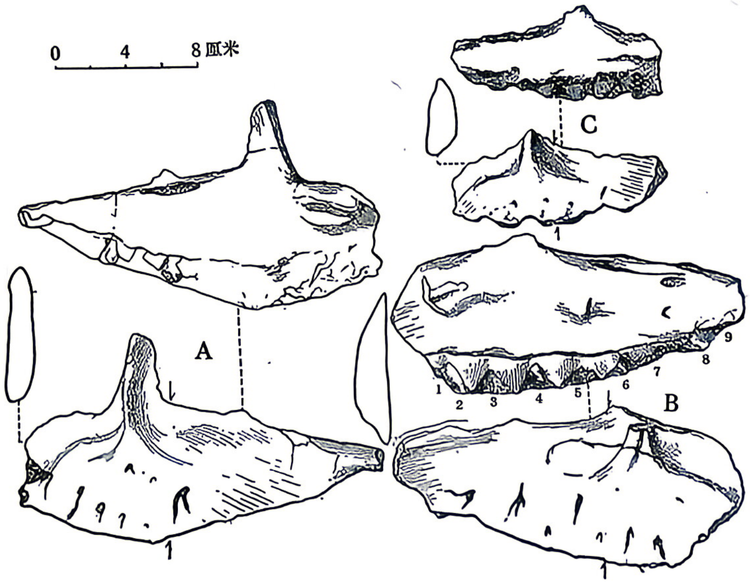


图 10　山西山西鳄，新属新种

A. 左；B. 右；C. 左上颚骨，外視与内視，附中部切面。1—9 表示 B 的牙窝。均原大四分之一。
C. 可能为黑峪口山西鳄。

Fig. 10　*Shansisuchus shansisuchus* gen. et sp. nov. A. left; B. right and C. left maxilaries in lateral and inner views with the outline of cross-section near the middle. 1—9 indicate the teeth or aveoles of B. 1/4 nat. size. Specimen C. may belong to the other species *S. heiyuekouensis*.

上有一明显的沟,已在上面叙述过。在大多数情况下,那前上颚骨前上的那一突起缺失了,有些情况可能是生前受伤,中間向后的突起的末端也有时缺失。在許多情况下,一些前上颚骨的下緣也不完全。

前上颚骨的外面只微为凸起,沿下边有至少六个神經孔,在成年标本,更为清楚一些。在上部較后端和第二眼前孔下端很近,有一长而深的沟。这个沟向前向上延伸,然后分为三个小沟。这个情况也是在成年标本較为清楚,而在幼年者不很显著。前上颚骨的前緣,一般較直,但有些微凹,前上突起如果保存,是比較纤弱,內側扁平。較长的中部向后突起,內側扁平。較长的中部向后的突起,在成年标本,內側具有一較深的长沟,上部較平。在其他标本,不甚显著。介于两突起的中間为縫合处,乃前上颚骨的最厚部分。縫合面內側是平的,而且向下逐漸变窄一直到牙槽边緣。在前上颚骨上部,介于縫合綫和后部突起之間,有一显著的、平的三角面,在成年标本,特别清楚。在此以后,內鼻孔(choane)的前緣可辨認。在許多标本,牙齿的遺迹,或者所留下的印痕表示牙槽的形状可以辨認出来。

**上颚骨**:大多数上颚骨全很破碎,有些十分不完全,以至难以辨别左右。尽管如此,有相当多保存較好的标本,使我們能够了解上颚骨的形状和主要結构。

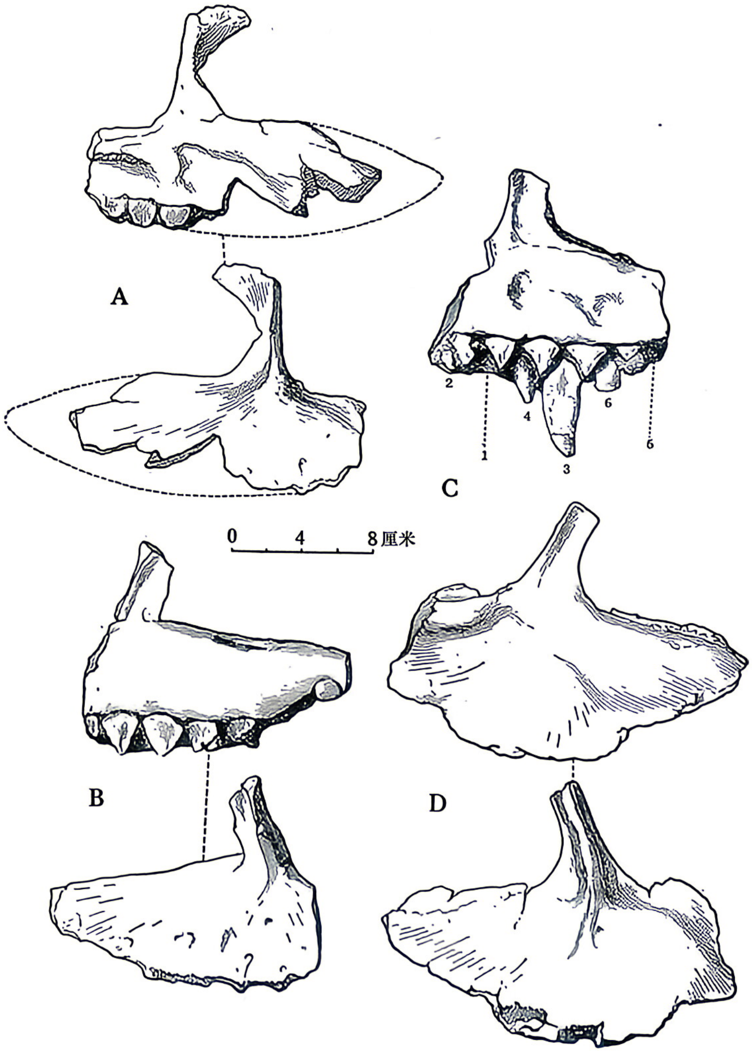


图 11 山西山西鳄,新属新种

A—C. 右; D. 右上颚骨外視与內視,詳见正文。均原大四分之一。

Fig. 11 *Shansisuchus shansisuchus* gen. et sp. nov. A—C. right; D. left maxilla in labial and lingual views. In B—C two generations of teeth showing as 1, 3, 5, and 2, 4, and 6. The odd number being those in function. 1/4 nat. size.

首先，我們应当肯定，比較平或甚至有些微向內凹的一边，应当当作唇側或外側，而相当凸起，甚至較为肿起的一边应当当作舌側或內側。理由是牙槽高的一边在平的这一边，牙槽边上的小孔也在平的这一边。此外上顎骨前端下部的深沟(如保存的話)和前上顎骨下后端彼此符合地相接連。

从外側看，上顎骨的最高处位于上突起处，而此突起在多数情况是缺失。这个突起为第二第一眼前孔的分界。突起的根部，起于外側前中部，然后逐漸向后弯曲。图 11 A 显示第一眼前孔的前部形状特为清楚，在其他标本(图 10，图 11)也多少表示出来，图版 I 的两上顎骨也很明显。在两图所示的标本，也表示出向上突起的細微不同之处，特别在向上突起以下处，上顎骨的下緣，向下凸出。上顎骨向后显著的变窄。末端很尖銳，在两眼前孔之下，上突起根部有一不显著的稜，显然为附着肌肉之用。

在上顎骨內側牙槽边緣，比外側边緣特别高，其下具有折曲状的三角形骨片。从上边看，上顎骨是笔直的，沒有象武氏鳄(*Vjushkovia*)那样向前向外側弯曲之状。上突起以前的較厚的具有阶状部分为和腭骨接触处，另外在其后的一較弱的部分为和翼骨接触处。上顎骨的后部上边的沟状部分，为和顴骨接触处。象第 10 第 11 图所示，上顎骨的大小差别很大。图 10 C 虽小，但不是一年輕个体，很可能不归于此种，而为黑峪口山西鳄。另外一方面一些較薄的标本，两边几乎差不多的平，当代表一幼年的个体。

**顴骨**：所有顴骨都是分散找見的。也很破碎。但把各部分拼凑起来，可以相当可靠的得到原来形状。顴骨的构造，对于了解下顳顬孔和眼眶下部的形状十分重要。顴骨的上突起(和后眼骨相接触)几乎和下部的前后軸相垂直。前边所成的有比直角略大，后边的角很宽作环圆状。紧靠上突起下，顴骨的下緣向上突出的向上凹入。向前突起的末端与上顎骨和泪骨接触处似突作断切状向上弯曲。很可能，这个突起的末端为第一眼前孔后下角的一部分。前端突起，比較其他部分較厚。向后伸的突起宽而薄，起初較宽，然后較突出地变窄，最后成为薄而窄的末端。这个突起后部遮盖着方顴骨前突起的外側(图 12)。

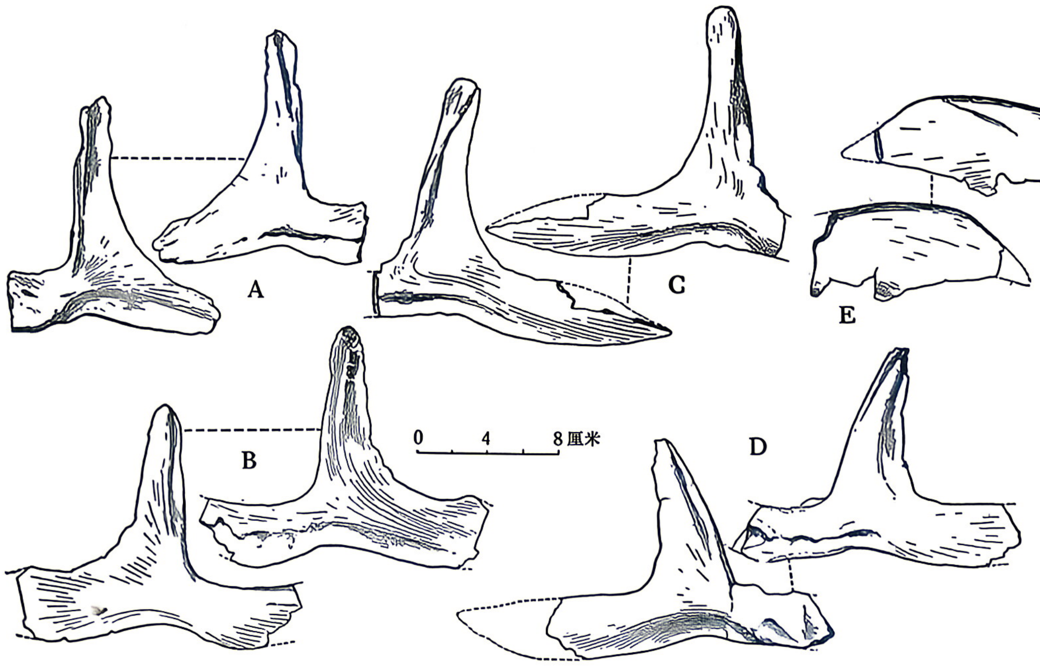


图 12　山西山西鳄，新属新种

A. 右；B. 左；C. 左；D. 右；E. 左顴骨外视与内视。F. 来自宁武二馬营孙家沟。均原大四分之一。

Fig. 12 *Shansisuchus shansisuchus* gen. et sp. nov. A. right; B. left; C. left; D. right and E. left jugal in labial and lingual views. E from Sunchiakou (V.2501). 1/4 nat. size.

总的說来，我們标本的顴骨和 *Vjushkovia* 的顴骨很象，只有些微小的区别。但是依照許耐的再造图(許耐，1960：pl. 12, 1)，我們的顴骨后端位于方顴骨外側，而許者在內側。山西鳄的顴骨后端必须稍向上摆，

以使可与上颚骨形成一向上凹入形状。

顴骨的大小和厚薄，差别很大，有些特小的可能归下述的另一种。图 12 E 的 V. 2501 左顴骨后末端特大特厚，就是这个标本証实。在我們的种，顴骨确在方顴骨外側。

**方顴骨**：这是一个大体上呈三角形状的骨，其向前伸出部分和顴骨連接。外側較凸出。下边比較厚，特别是后部。在后下部末端，內側有一浅的凹入面，显然为与方骨下外部接触之处。上部末端相当圓，向前伸出部相当窄，和顴骨相接的迹痕，十分明显。表示其后突位置很向后，紧在上尖端以下。在方顴骨的前緣，紧位于向前伸出部分之上骨，特别加厚，有一很深的沟沿下部的边緣。此沟向上逐渐消失，为接触鳞骨之处(图 13, D—K)。

**方骨**：在許多破碎的方骨中，只有两个方骨，比較完整。方骨构造，在大体上可以和 *Vjushkovia* 的相比較，很相似，很可能两个方骨的內翼和翼骨接触处近于完整。如果如此，和翼骨接触的最伸延部分相当低，同相当大的头骨比較，近端和鳞骨接触部相当的小。外側的一翼介于两关节之間，只有 22 毫米宽。从近端到远端，两翼所成之角約为一直角。从后面看，远端以上部分相当收縮。远端后边的上部相当之平，但另一面十分凹入。两尖卽成一約 40° 的角(图 13, A)，远端可能为病态的稍有变形，在远端以上有一突起部分(图 13, A—C, C 属 V. 2501)。

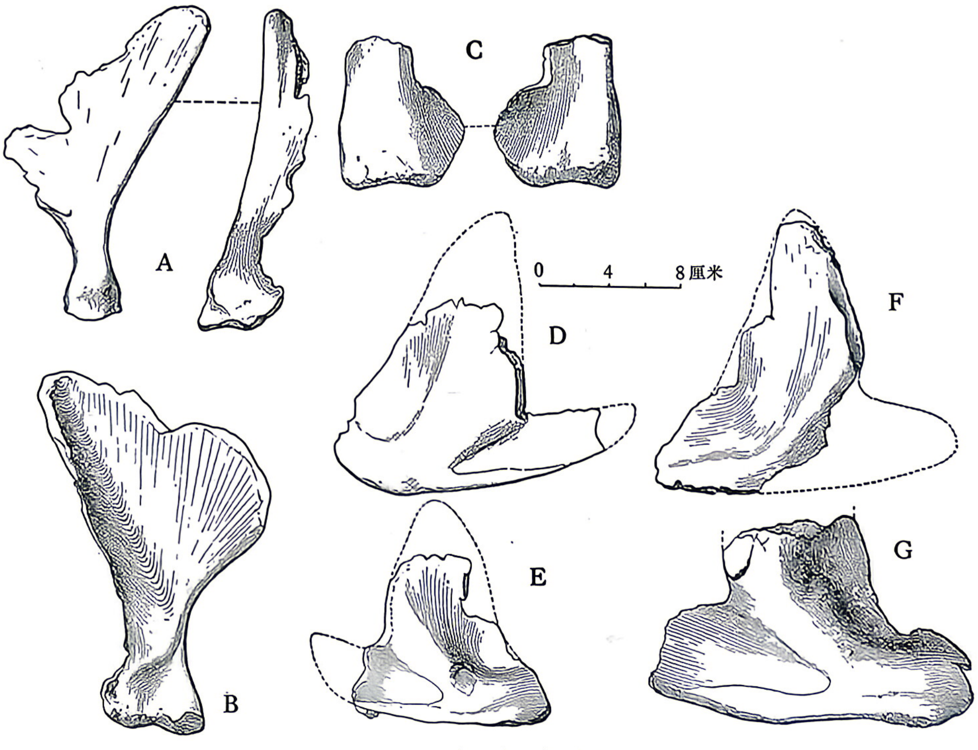


图 13 山西山西鱷，新属新种

A. 右方骨后視与側視；B. 右方骨前視；C. 右方骨远端后視与前視(宁武孙家沟 V. 2501)；D—G 方顴骨；G 来自孙家沟。原大四分之一。

Fig. 13 *Shansisuchus shansisuchus* gen. et sp. nov. A. right quadrate in anterior view; C. distal end of the right quadrate in posterior and anterior views, from Sunchiakou (V.2501); D. right quadratojugal; E. left quadratojugal; F. right quadratojugal and G. left quadratojugal from Sunchiakou, (V.2501) in lateral views. 1/4 nat. size.

**鳞骨**：只有少数鳞骨保存相当之好，但是沒有一个完全的，也沒有一个和头骨相連接的。鳞骨为一长骨，外凸而內凹。在多数标本，后眶骨在鳞骨上接触的痕迹还可看出。此为一尖状部分，几达骨的后緣，微向外斜。在此以后，一較平或稍微凸起的面(一般在較老个体淸楚一些)乃为和顶骨后突起接触之处。鳞骨的前緣，在有些标本或多或少保存，此卽下顳顬孔的后边。鳞骨的上后角相当鈍，逐渐向后弯曲。从眶后骨印

痕处后緣起向下(微向前)延伸，然后逐渐消失于骨的前緣。此清楚的为附着顳顬孔筋肉之用，鱗骨下部逐渐变薄，和方顴骨相接。此处也形成下顳顬孔的下后角(图 14，A—C)。

保存的鱗骨大小不一。大者相当之厚而碩大，小者薄而纤瘦。但都有上边所叙述的斜的稜。 虽然大小不一，也有些不同，但总的說是属于年龄之差异而归于一个种。

**翼骨**：只有两个很不完全的翼骨保存。保存較好的一个(图 15，A) 很象許耐所描述的左边內側面 (此标本另一面尙附着于岩石上，因骨太薄未露出)，但比較小。但是这样摆法和再造起来的头骨相比 (見下) 不能把图的上右的較小突起和方骨相接，相反的宽的可以和下左宽的一突起相連，可惜这一部分，保存很差，有損伤。以下描述卽根据这个摆法。

这一标本可能属于一幼年个体，和基蝶骨相連部分很为收縮。翼骨前边可分为两部分。 向前伸的一部分，为口腔前部腹側的組成部分，其上有一显著的稜，內側还有一較宽的稜。 两稜在近于和基蝶骨的相接面处会合。另一部分，向上伸成为比 90 度略小之角。一特别显著之稜位于后緣，其末端很为尖銳。后端和方骨相連部分比較宽，其平面似乎和(有破損)翼骨前部的直立面有一些扭折。从腹側看和基蝶骨接触的部分相当之窄。翼骨中

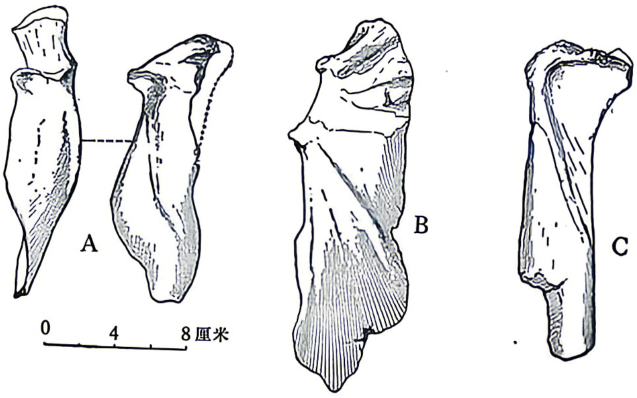


图 14　山西山西鳄，新属新种

三鱗骨。A. 后視与側視；B 和 C. 側視。原大四分之一。

Fig. 14 *Shansisuchus shansisuchus* gen. et sp. nov. Three squamosals. A. in posterior and lateral; B and C. in lateral views. 1/4 nat. size.

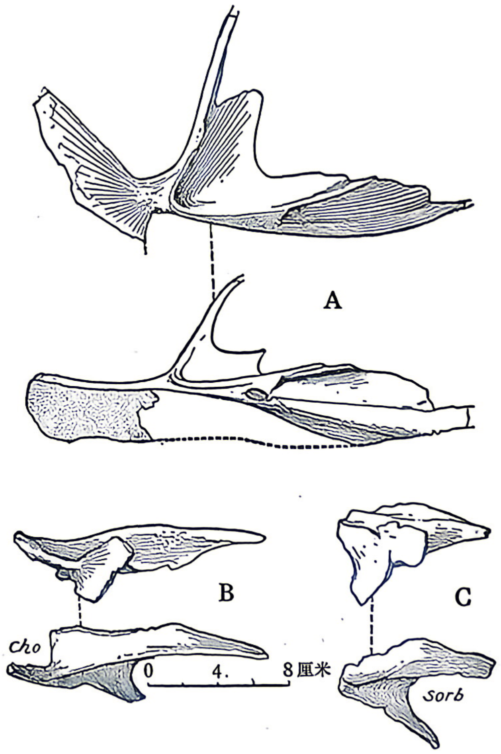


图 15　山西山西鳄，新属新种

A. 左翼骨双面視；B. 左腭骨双面視；C. 左腭骨。

Fig. 15 *Shansisuchus shansisuchus* gen. et sp. nov. A. pterygoid in two views; B. left palatine in two views; C. left palatine. in two views. Abbreviations: cho. choane; sorb. surborbital opening.

間孔的边緣，可以辨出。自此翼骨显著地变窄，其尖端已破損。翼骨上沒有牙齿的任何痕迹(图 15，A)。

另外的翼骨很破碎，无何可記，好象也是右側其間內延伸部分，卽与翼蝶骨相接处，比前一标本保存較好一些。也比較小，如果属于此种的話，也当为一幼年个体。

**腭骨**：有三个单一的骨骼，最好当作腭骨。計有两左，其中之一保存較为完全，另一为右边。作屈膝状折曲的一边，为和翼骨接触之处。外側一边，可以看出內鼻孔和下眼孔(图 15，B，C)。

除了以上所述的以外，沒有其他可归于头部的骨骼，在正型头骨的腹側， 和 V. 2508 头盖骨上似可以看出 cornua branchialia 的存在。

关于头骨的測量，可看表 4 (頁 124)。

## 下　　顎　　骨

沒有一个下顎骨是完全的。但保存的标本相当多，各部分全有，因之有可能得到整个下顎的主要性质和一般概况。首先，山西山西鳄的下顎骨，具一个大的圓角长方形下顎孔。除此以外， 下顎的一般构造和引鳄

相当相近(图16—18)。

**关节骨和上隅骨**:在所有标本中,这两骨的分界都不十分清楚。一些保存較好的标本,显示出围繞着关节骨关节部分。关节骨除了关节面的后壁以外,几乎向后沒有什么伸出部分。在这一性质上和武氏鳄(*Vjushkovia*)以及相近各属,都不一样。关节面本身很开展,清楚地向外侧(图16,E,开口处为46毫米)。在关节面以前,向前显著地变宽,完全由上隅骨构成。在上緣以下,有一发育很好的平稜。此在关节骨前特別显著,愈向前愈变弱,而消失于下顎孔的上边附近。在图16E,下顎孔和关节面的距离为105毫米。在同一标本可看出下顎孔的輪廓,为圓角长方状,至少后部如此。下顎孔向前向下伸,其前緣为齿骨的最后部,此在图16C可以清楚看出。这是我們的唯一标本,表示齿骨和上隅骨的天然接連。上隅骨前外部分的沟在多数保存較好的标本上十分清楚。特別是未成年的标本,例如图16D所示。由外侧看前关节骨的后尖可以隐約辨出。夹骨后尖也似存在。

**前关节骨、夹骨和冠状骨**:在图16E,此三骨看的最清楚。那棒状差不多平摆着的骨无疑为前关节骨,在后端前向下向外的加厚可以清楚地看出。前端已破損。在这个骨以下,沿下顎的下緣,中間最高,两端变低(前边已破)另有一骨,卽为夹骨。在此两骨以上,內侧一边有一較斜的骨,作为关节骨前壁的向前向內延伸部分,卽为冠状骨。三个骨好象都在原来位置,并未有任何錯动。

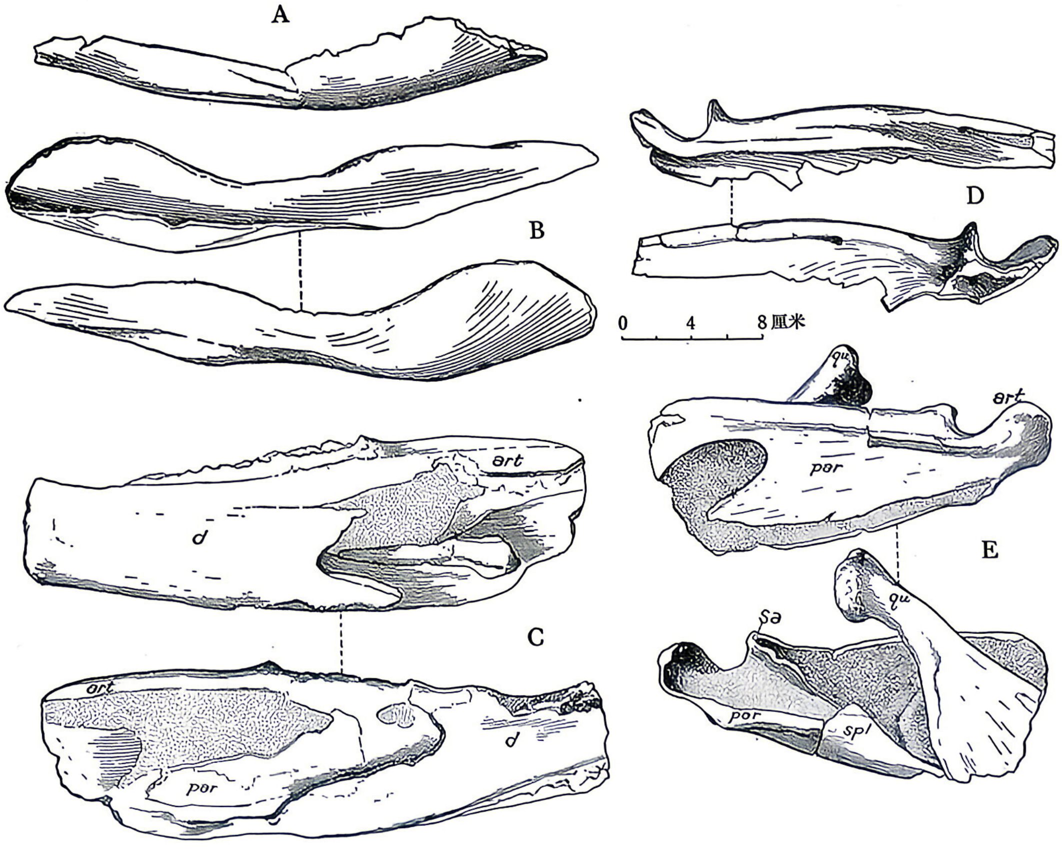


图16 山西山西鳄,新属新种

A、B. 左隅骨; A. 內视; B. 外內视; C. 左下顎后中部外內视; D. 右关节骨双面视; E. 左关节骨与前关节骨等。均原大四分之一。

Fig. 16 *Shansisuchus shansisuchus* gen. et sp. nov. A. and B. left angular, A in inner B in lateral and inner views; C. posterior middle part of a left lower jaw in lateral and inner views; D. right articular in two views; E. left articular and prearticular and splenial in outer and inner views. All 1/4 nat. size. Abbreviations: art. articular; d. dental; par. prearticular; qu. quadrate; sa, surangular spl. splenial. All 1/4 nat. size.

**隅骨**: 除了許多零碎的碎片外,这一骨有两个十分完整,都是右隅骨(图 16, A 及 B)。隅骨的形状, 非常和許耐所記述的引鰐的隅骨的形状相似。但在我們的标本,后端比較鈍,几乎沒有清楚的伸出部分。隅骨的下緣微向下弯曲,下外側形成一較平的面。在較年輕的个体(图 16, A), 这个平面較向下, 所以从側面几乎看不見。保存的总长: A, 285 毫米; B, 335 毫米。最高度: A, 44 毫米; B, 56 毫米。

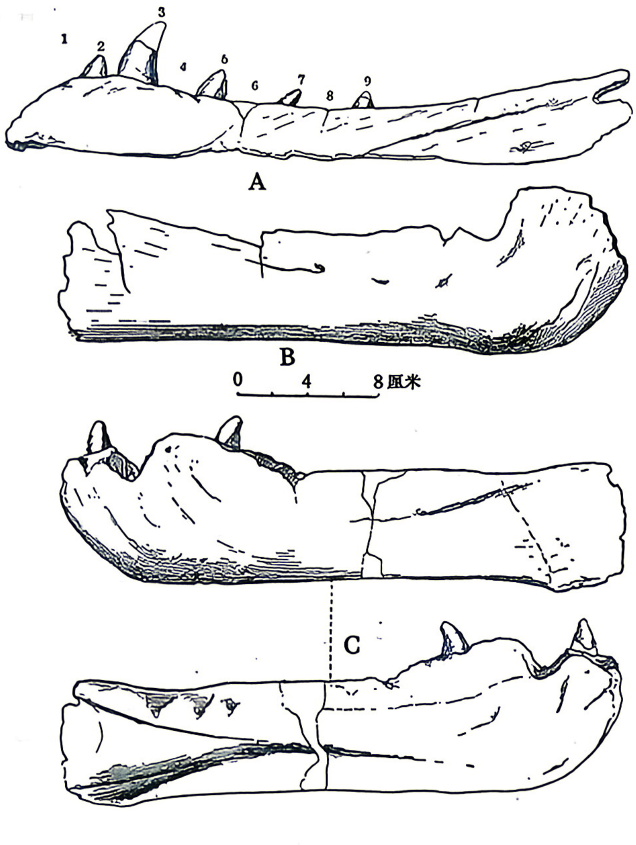


图 17　山西山西鰐,新属新种

A. 左; B. 右; C. 左下顎外視 (A—C) 与內視(C); A. 1—9 表示牙齿順序数。原大四分之一。

Fig. 17 *Shansisuchus shansisuchus* gen. et sp. nov. A. left; B. right and C. left lower jaws in outer (A—C) and inner (C) views. Alveoles and teeth are shown in number 1—9 in A. 1/4 nat. size.

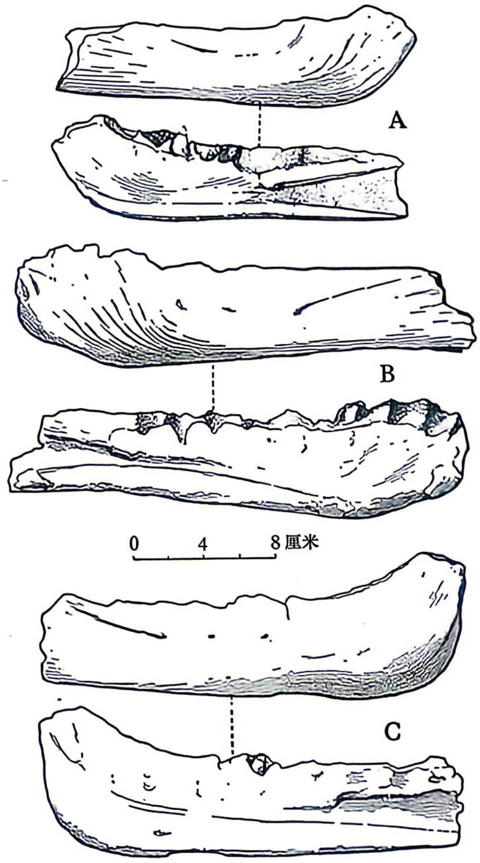


图 18　山西山西鰐,新属新种

A. 右; B. 左; C. 右下顎,外視与內視,表示大小与年齿的差別。均原大四分之一。

Fig. 18 *Shansisuchus shansisuchus* gen. et sp. nov. A. right; B. left and C. right lower jaws in outer and inner views, showing the difference in size and age. 1/4 nat. size.

**齿骨**: 只有极少数的齿骨是完整的或者近于完整的,大多数只保存了前端部分近縫合綫处。 在个別的情况下,有些牙齿还保存在原来的位置。較好的标本見图 17 和图 18。

总的說来, 齿骨比較瘦小。下緣比較直。齿骨前, 即縫合处非常的加厚, 外下側有放射状沟稜, 有的很清楚。齿骨后部的內側, 薄而平, 前部有銳角的边, 即为夹骨伸入之处。近下顎骨孔前端的分叉状部分, 幷无一个标本保存, 但似无疑閒存在。齿骨的外側有一前后伸的沟, 年輕个体較为清楚, 年老不很清楚。 齿骨的后部, 幷未特別的加寬, 所以下顎的上边和下边在相当距离是平行的, 只有近前端加厚的部分, 可以除外。

## 牙　　齿

和相当多的上顎和下顎来比, 牙齿保存的幷不算多。大多数的牙齿都是分散的零碎的。 只有极少数的牙, 还保存在原来上顎或下顎的位置。虽然有許多上顎和下顎保存, 但还是不能弄清楚上顎和下顎的实际牙

齿数是多少。只有前上颚骨显然为五个牙齿。最完整的上颚骨,至多为十个牙齿,或更可能一些为九个。所以上牙一共当为十四或十五。保存最好的下颚,似乎表示其牙齿数为十四至十六之間(图19)。

牙齿是典型的次槽齿式的(sub-thecodont)。

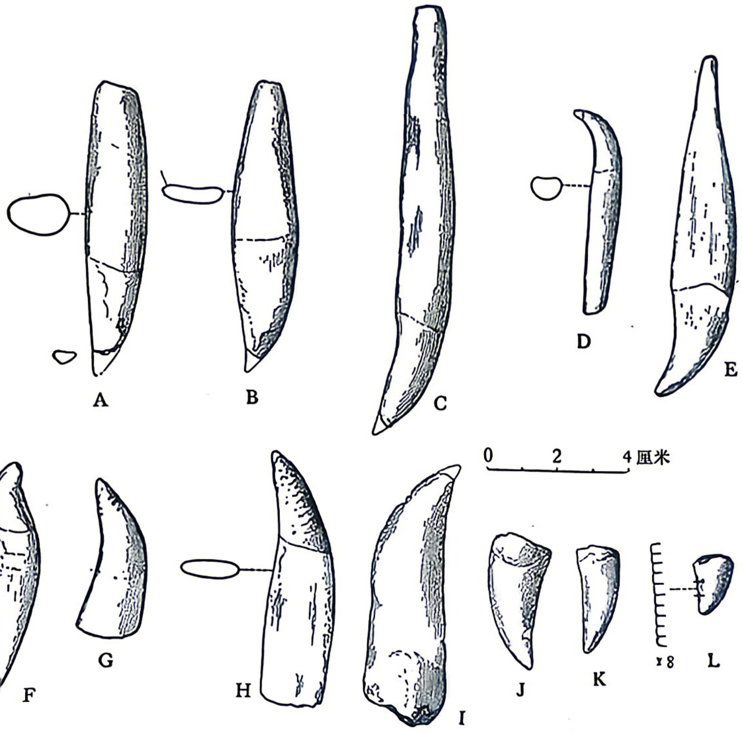


图19 山西山西鳄,新属新种

A—L. 一些上下牙齿。原大二分之一。詳見正文。

Fig. 19 *Shansisuchus shansisuchus* gen. et sp. nov. A—L. a few teeth of upper and lower teeth with cross sections and enlargement of the posterior serrations of L (×4). 1/2 nat. size. The upper and the lower teeth are not certainly identified. For details see text.

前上颚骨的牙齿具有非常长的根,而牙冠比較短。从侧面看,牙冠为枪状輪廓,只微向后弯。牙的前緣和后緣都具有很精致的鋸齿状构造。牙根比牙冠长四到五倍。两边多少扁平。在較成年的标本,牙根的切面,可以是扁圆或近于圆状的。牙根最粗处和最宽处,位于中部。其中空部相当之大。单一的牙齿不容易定出在牙列中的序位。但从保存較好的前颚骨判断,第一个牙比較小,第二个牙和第三个牙最大,然后依次显著地变小。在許多标本,可以看出紧在正用的牙齿下边,有代替的牙齿的成长。这些牙当然小一些。零碎的单个牙齿中,有一些是归于这一类的牙齿。

有极少的几个上颚牙齿还保存在上颚的原来位置上(图10,11)。所有两图上的牙齿,还才使用或未怎么使用,所以是新牙。牙槽的內緣,相当之直,或微作凸出,位置也比相当于唇侧的弯曲度高一些。在舌侧牙槽之下,有一排特殊的、多少有些三角状的骨质板极为发育。这个性质和华萊士所描述的 *Arizonasaurus* (1947)十分相象。我們的标本,比之还要特别发育一些,象以前所指出的,上颚骨內凸而外平。北美标本,也是这样。

比起前上颚骨的牙齿来,上颚骨的牙齿,特为扁平,也較向后弯曲。前后緣也具有精致的鋸齿状。在一标本上(图11, C)有三个新冒出来的牙和一个較长的用过的牙。此外好象还有两个空的牙窝,代表已用过而掉了的牙。似乎很清楚,正用的牙和要代替的牙作交互状排列(在图上以单数和双数表示)。

**下颚的牙齿:** 沒有上牙那么清楚。在零星牙齿中,那些牙根較长,牙冠較低,向后較弯而尖的牙,应当为下颚前部的牙齿。沒有一个这样的牙在牙床上保存,但在一些标本上表示有較圆而大的牙根断面。和前颚

骨的牙相比，这些牙较小较尖，而牙冠也稍为高一些。这一类牙以許多单一牙为代表，年龄也不一样。特别年幼的牙，清楚地显示出扁一些，尖一些，也更为向后弯一些。其前后緣也有鋸齿状，但比以后的牙齿稍粗一些。

其他較后位置的牙的构造和上牙差不多。所以有时很难分别零星的上顎和下顎后部牙齿。和上牙一样也是比較更为扁平，两緣有鋸齿状，而更向后弯曲一些。虽然如此，有些单一的牙，其牙冠底部和根部相当地变粗。这可能是年龄的关系。图17A，表示一排新用的牙，自前向后逐次減小。在这一标本也清楚地看出，象上牙一样，用的牙和代替的牙是交互出现的。

总的說来，山西山西鰐的牙齿，是肉食性的，相当凶猛，很可以和后期肉食类恐龙的牙齿相比較。在中国肯氏兽时代，恐怕是最凶猛的一种动物。从牙的构造上講比較簡单。就用途来講，前边牙齿用于进攻夺取，后边牙齿用于割切。

## 关于头骨的再造

把头骨各部分加以描述之后，现在可以有条件談一下头骨的构造和复原。此自然只是初步的。可能包括一些不正确甚至錯誤的地方。这因为大多数的材料是零散的，有些是十分破碎的。另有若干骨未曾发見或者很不完全。尽管如此，由于材料很丰富，使我們有可能得到山西山西鰐头骨的大致完全概念（图37，图版IV—VI）。

利用了六个比較完全的头盖骨，配上了相近的上下顎和其他骨，复原了六个头骨。不用說，这些都是綜合的。在某些情况下，大小不很合适。尽管如此，头骨的基本构造，各孔的相对位置和大小都是十分可靠的。

在正型标本（V. 2503），綜合部分相当完全。只有极少数骨骼付之缺如。在眶后骨（部分补全的右眶后骨亦然），对于这么大的头骨来說，可能大了一些。其他部分好象都很适合于这个头骨（虽然他們不可能归于一个个体）。这一头骨代表一成年个体。

另外一头骨，其脑壳部分局部保存（V.2506），好象代表一个比上一标本稍年輕的个体。因为額骨和鼻骨的縫合綫很松，眶后骨的向下突起也显得小一些。但是年龄不可能相差很多，因为其他骨的縫合綫都是很密，且有些难以辨認的。配上去的其他骨可能大一些，但一般說来，很合适。

V. 2508的再造也大体合适，但比以上标本較不完全，这是一成年个体。

和V. 2504装起来的头骨也較合适，只是所附的上顎骨看去稍小一些。这是一个比較大的个体。

V. 2505代表一較年輕个体，但这不是最年輕的，因为在我們的材料中，还有若干前上顎骨上下顎等，看来比这还年輕。但是装在这个头骨上的上顎，肯定地稍为大了一些。前顎骨也稍大一些。

V. 2501为宁武孙家沟的标本，具有头骨顶和头后部等。为了复原起来，使之更为完全一些，我們用了一些武乡56173地点的一些骨骼，如前顎骨和上顎骨等。右边的这两骨（右前上顎骨乃由左侧者仿造而成）由于相接触处有一沟彼此相連，非常可能即属于同一个体。但尽管如此，人們有这末一个印象，即左和右上顎骨比起大的前顎骨来，好象小一些。V. 2501代表一大而年老的个体，它是我們所有材料中最大的一个头骨。

所有以上头骨（包括V. 2501），装配的下顎，也是綜合的取材自56173地点。可能不大合适，相当主观。即使每一个下顎的再造，前部与后部也不一定同属于一个个体。

尽管还有些可疑的地方，但根据以上六个头骨的复原，使我們可以得到山西山西鰐头骨的形状和构造。其主要的特性可以概述如下：

头骨的长度一般可靠，主要由头骨的鼻骨前端到間顶骨后端，再加上前上顎骨的长度，即为头骨的总长。鼻骨前端的缺失部分，很容易改正，使前上顎骨的向后突起比較适合地插入于鼻骨的相称的沟即成。头骨下緣的长度也易判定，即为前上顎骨、上顎骨、顴骨，再加上方顴骨的总和。按照我們目前的复原方式，方骨在侧面看不見。方骨的位置只稍微向后傾斜一点，几乎直竖，很有些象引鰐和其相近的属。根据这个情况，头骨后部的高度，就可相当准确地定出来。总的說来，头骨的后面，差不多是直竖的，或者只稍微向后傾斜一点。头骨后端的宽度，由装起了的鳞骨、方骨和方顴骨来决定。眶后骨和鳞骨的关节式接触，以及后者和方

额骨的同样接触，使得它們的位置相当固定。在这样情况下，两方骨的末端，只稍微向外侧斜一点。

因为大多数下顎的前端縫合綫处，保存不好，而后部也很破碎，所以下顎装配的角度主要靠和方骨关节处放合适为准。

因为所有六个头骨的装配所获得的結果，都是一致或大体相同，所以我們相信所装的复原是距眞实情况很近的，如不是完全对的話。

从上面看，头骨作等边三角形，前角很尖。上顳顬孔和鼻孔完全可以看見。而其他孔都在上視看不見。枕髁孔的一面，也看不見。

从侧面看，头骨也是比較延伸的。其最高处为头后部。枕髁面微向后傾斜，几乎可以看不出。除了上顳顬孔口向上开，在侧面只看到一小部分外，其他孔都在侧面显示出来。头骨的上緣，从最高处的間顶骨部分起，到前上顎骨的最前端止，逐漸向前傾斜，成一緩坡。头骨的下部边緣有些微弱的波状突起。这主要由于前上顎骨和上顎骨間微有向上凹曲，额骨前端有些向上弯，泪骨以下也可能如此。前上顎骨和上顎骨間的弯曲，很輕微，根本不能同 *Elaphrosuchus* 和加斯馬吐龙来比，其弯曲程度至多可与引鰐或 *Garjainia* 相比。

最不清楚的是头骨的后面观。头骨的后面只有宁武一个标本(V.2501)局部保存。但尽管如此，所有六个头骨的复原均表示，方骨的末端只輕微地向外斜。整个后面的輪廓，几乎是方形的，实际上高度微微超过了宽度。这和許耐所复原的引鰐头骨恰恰相反。

因为头骨的腹侧保存很差，非常不完全，所以沒有打算把腹侧加以复原。

下顎从侧面看，比起大的头骨来，是相当小的。因为沒有一个完整的下顎保存，所以下顎的长度只能加以估計。很可能下顎的位置比头前部稍微向后一些，但不特向后，有如 *Garjainia* 那样。下顎中部上沿的微微弯曲，似乎和上顎的向下凸出是相适应的。

关于上顳顬孔有好几个好的标本保存，用不着有什么疑問。此孔以顶骨和眶后骨为界。但鳞骨参与了外后角的一部分。顳顬孔的前边几乎和头骨的长軸相垂直。而外边則和头骨的长軸大約平行。外后角成一銳角。

下顳顬孔上边为眶后骨和鳞骨，前边为眶后骨和额骨，后边为鳞骨和方额骨，下边为额骨和方额骨所界。下顳顬孔的四角为：上前角，广闊的鈍角；上后角微作鈍角；下前角約为广闊的鈍角；而下后角則近于直角。这四个角分別由不止一个的眶后骨、鳞骨、额骨和方额骨代表，所以十分可靠。下顳顬孔的形状为圓角长方形，其高度显著地超过了宽度。此外上边比下边为短，前边比后边为短。下顳顬孔的后面，不象其他若干种属一样，有显著的膝状折曲。

眼孔的上边为前额骨和后额骨，前边为泪骨，下边为额骨，而后边为眶后骨所界。如上边已經指出的，额骨未参加眼眶的边緣。因为泪骨和额骨保存不太完全，关于眼孔形状有几点不十分太清楚。但尽管如此，象V. 2506头骨，围着眼孔的上部和后部大致保存，其形状还是十分可靠的。泪骨和额骨接触处相当不清楚。按照我們现在所做的复原，眼孔的形状是橢圓形，其向后向上的延伸部分，为眼珠所在界以前額骨、后額骨和眶后骨下突起的上部。

除了后边一部为泪骨所界外，第一眼前孔的形状，是很清楚的。上部为鼻骨所界，下部为上顎骨上边所界。虽然有些不完全，但鼻骨向前下伸出的突起和上顎骨向上后伸出的突起的彼此相連接是毫无疑問的。进一步这两突起的彼此連接也形成了第一眼前孔和第二眼前孔的分界，也是毫无疑問，非常清楚的。第一眼前孔的后边为泪骨。另外一点，额骨的前端，和上顎骨后端相連接，也应沒有疑問。第一眼前孔的形状为圓角三角状。它的大小恰介于眼孔和第二眼前孔之間。

第二眼前孔的后界为上顎骨的向上突起和鼻骨的向下向前伸延部分。第二眼前孔的上緣为前額骨的向后突起和鼻骨。这一边向前向下伸，其前下角为前上顎骨所成。第二眼前孔的下边为前上顎骨后部和上顎骨前部所成。第二眼前孔的形状也大致为圓角三角状，其上后角为鼻骨所构成。在前上顎骨后下部，有一較深的宽沟，向后延伸以和上顎骨前端相应的沟相接。在这一部分，向內凹入，作为第二眼前孔下边的向下伸延部分。第二眼前孔的前下角局部地位于鼻孔后部之下。

和那么大的头骨比，也和其他多数孔相比，鼻孔是相对的較小。两鼻孔中間为前顎骨的上突起，向后插

入于两鼻骨之間所隔开。鼻孔形状为伸长的椭圆状,位于鼻骨的很靠前端。鼻骨的后部迭于第二眼前孔之上一部分。鼻孔上为前上顎骨和鼻骨所界,而下边则全为前顎骨所界。

从表5(頁130)可以看出已装配的六个头骨的主要尺度。

因为所有复原的头骨都是綜合性的,表5所示的数字,当然不是眞正的大小。但是很清楚,这些数字虽不完全准确,但距眞正的数字很相近。因为多数骨骼保存很好,少数缺失部分,可由保存較好的一面补充,誤差很小。以上数字,至少可以看出一些年龄不同的个体的大小比較,自幼至老。但 V.2505 肯定不是最年輕的。在我們的材料中,有些更年輕的前上顎骨和上顎骨等。但是沒有观察到新孵化出的任何个体。

## 脊椎骨和肋骨

虽然材料中有很多的脊椎骨和肋骨,但几乎所有的标本,均零散地发見,几乎沒有什么三个或四个以上連接一起的脊椎骨。此外所有脊椎骨和肋骨都保存很差,以脊椎骨讲大多数为椎体,以肋骨讲为頂端部分。因此,这些标本和头部遺存的关系是非常不清楚的。但一般地有可能区分出頸、背、荐和尾部脊椎。但是每一脊椎的准确位置和次序就很难准确地定出。我們也放弃对零散的破碎的脊椎突起,以及其他破碎的神經弧部的骨骼的鉴定。

**頸脊椎:** 比較上只有少数頸脊椎保存。沒有清楚无疑的环椎,但有四个它的間脊椎保存,大小不一。最完全的一个見图 20 C。由腹面和側面看这是一个半月形的骨。向前伸出部分比較突出,具有左右伸张的和头骨髁关节的面。这个面的两側各成为一半球状面,乃是和頸肋骨接触处,亦即为椎体突。从腹面看,骨面光滑,具有清楚的前后边緣。宽 55 毫米;腹側长 21 毫米;高 31 毫米。

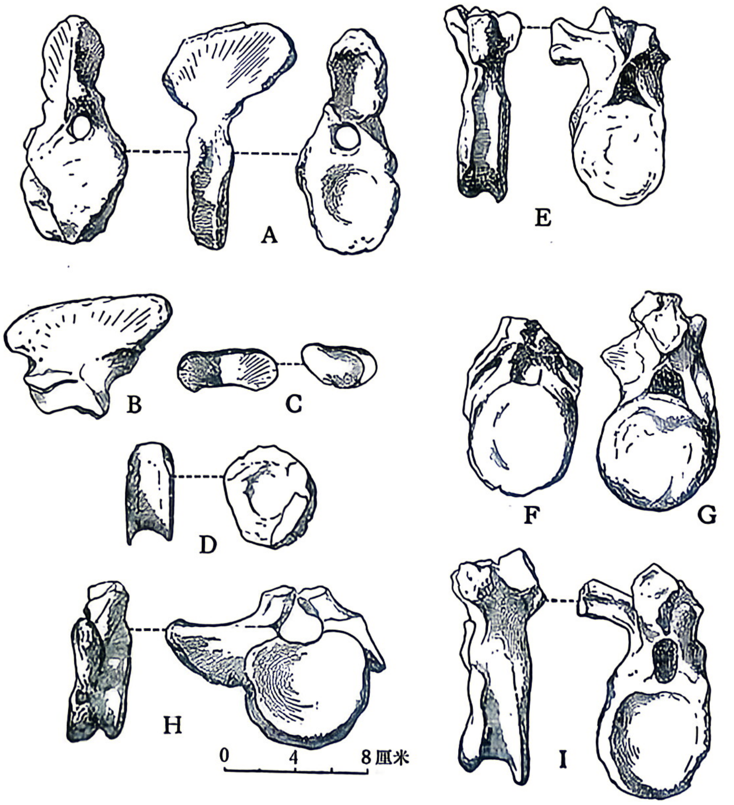


图 20　山西山西鳄,新属新种

頸脊椎。均原大四分之一。詳看正文。

Fig. 20 *Shansisuchus shansisuchus* gen. et sp. nov. Neck vertebrae. For details see text. 1/4 nat. size.

关于第二頸脊椎,只有一个标本,只有一个椎体和上边的弧尙自然連接(图 20, A)。另有三个背棘也当作归于第二脊椎的背棘(图 20, B),椎体的前面扁平,其下部稍为凸出。 大体輪廓为三角状, 腹側为一清楚的銳角。椎体的两側显著地收縮。椎体后面微为凹入。高度稍微超过宽度。椎体非常之短, 少于后面宽度的一半。椎体突只輕微地在椎体上側部显示出来。神經孔相当的圓。背棘碩大,其后端加厚,后腹側有一深沟。背棘上的曲度向后逐渐弯曲,远不如武氏鳄之陡。

另外有几个第二頸脊椎只以椎体为代表,其构造和上述标本十分相近,但也有一些差别。椎体边緣的翻折有的輕微到几乎沒有,有的較显著,可能由于年龄不同而异。有几个标本两边发育不对称,在图 20E, 其一边作断切状,几乎无椎体突的遺迹,但在另外一边(左側),发育很显著,这显然是病态的发育。相似的情况也在其他第二頸脊椎看到。

以下的頸脊椎可以由好几个特点来辨别。椎体比較短,前后边翻折显著,椎体中部相当收縮等等。关于頸脊椎的数目,我們不淸楚, 很可能为除第一第二外还有七或八个頸脊椎。 虽然頸脊椎的眞实次序并不知道,可是非常可能后边的脊椎加长一些,加大一些。

并沒有頸脊椎具有間椎的証据。但不能排斥这一可能性,就和引鳄一样,也具有間椎。就我們的两頸脊椎間所留的空,几乎等于零的情况看,卽有也是很小的,极可能是沒有的。頸脊椎的腹側, 一般是光的, 但在較老标本其后段可能有輕度稜状发育。椎体突一般不太发育, 特别是中部的頸脊椎。以后的脊椎稍微显著一些。椎体突的位置稍有不同,一般很低。所有脊椎都是輕微的双凹式的。因为几乎沒有一个頸脊椎具有背棘,其构造自然不淸楚。前后关节突有几个保存,都是很陡。椎体突也有几个保存,几乎是平的向外伸,在后部脊椎相当发育。

**背脊椎**: 除了来自宁武孙家沟(V.2501)的六个背脊椎外,所有其他大多数背脊椎都是零散找見的,在背部确实位置不淸楚,也不知道应当归于那一个个体。V. 2501 的那几个背脊椎保存很好, 有助于对山西鳄背脊椎的了解,在下面首先予以叙述:

V. 2501 有六个或多或少完整的背脊椎,見图 21。上边一排(A—C)属于背前部,下面一排 (D—F) 属于背的中部。头两个脊椎( A 和 B )代表最前的两脊椎第九和第十(或者第十和第十一), 很可能是相連接的两个脊椎。头一个脊椎的左椎体突还保存。此椎体突短而大,末端成三角状輪廓。这两个脊椎骨,还带了一些頸后部脊椎的性质。椎体較短,短于椎体的直径边緣翻折的情况在前緣还保持,其最宽处就是椎体突。椎体的宽和高度大致相等。椎体中部收縮很強。椎体前面只稍凹而后面較深。头一个脊椎的腹側有一不显著的稜,在椎体突上后部有显著的凹入。第二脊椎的腹側有两个平行的不显著的稜,其間微显凹入。椎体突上后部的凹入部分,比前一脊椎更为深一些,清楚一些。

第三个脊椎(图 21, C )可能代表第十二或第十三背脊椎。虽然椎体的直径比其长度还超过很多, 但比起以前的两脊椎来,椎体的长度有显著的加长。这个脊椎的椎体中部只輕微地收縮。 但腹側前部有一淸楚的中稜,但向后渐渐消失。椎体突发育很好,位于椎体旒下边的一半。椎体突后边并未以任何形式和椎体側面相連接。相反地,从側面看,椎体突的后緣还稍微伸出一些。椎体突两边均保存,比較短,微向下伸。椎体为輕度双凹式。前关节突比較长,相当伸出到椎前端以前。前关节突的前面有一沟,相当发育。后关节突短而宽,几乎未超出椎体的后边。背椎比較短,末端变窄,但显著地加厚。

其余以下的三个背脊椎,很可能代表第十六到第十八(或第十七到第十九)脊椎。因此, 也是相連接的。椎体两端比較凹入,特别第十六脊椎。第十六脊椎的椎体还比較短,但其后两个显然加长。这主要由于椎体宽度減小,和椎体本身也稍变长一些。第十六脊椎椎体腹側是光的,但其他两个有一中前后稜。椎体突已移到椎体以上而且也很小,第十六脊椎的椎休突稍向上伸一些,至其他两个的側边近于水平。第十六脊椎的前关节突,只稍微伸出于椎体的前緣一些,而后关节突則相当突出地超过椎体的后緣。其他两个脊椎的后关节突也显著地伸出于椎体后緣以后。第十七脊椎的背棘未保存。在两保存有背棘的脊椎(第十六和十八)末端只輕微地变粗,背棘稍宽,微向后伸。

另外一些相連接的背脊椎由兴县黑峪口的标本来代表(60116, V. 2513)(图 22)。一共有七个脊椎, 一个是靠前边的(第九或第十)三个是中間的(第十四一第十六), 另外两个, 在荐骨脊椎的紧前部 (第二十四

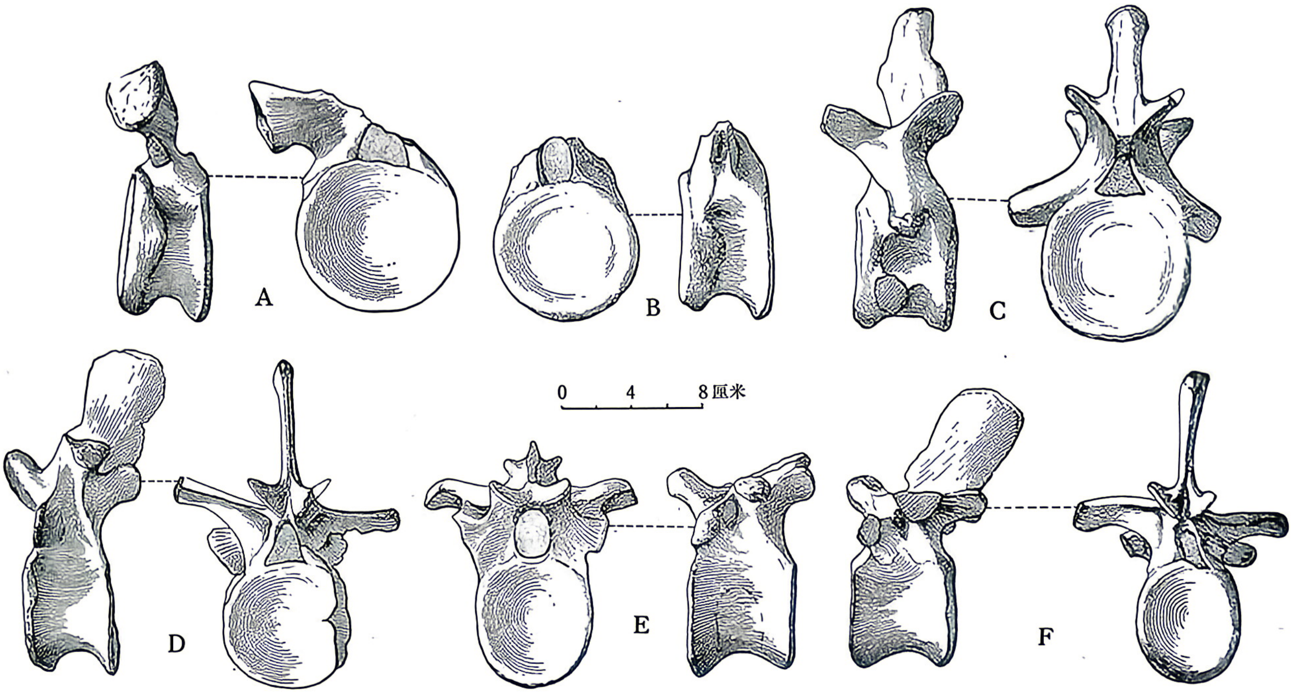


图 21　山西山西鳄,新属新种

孙家沟(V. 2501)六个背脊椎侧视与后视。詳看正文。均原大四分之一。

Fig. 21 *Shansisuchus shansisuchus* gen. et sp. nov. Six dorsal vertebrae from Sunchiakou (V.2501) in lateral and views. For details see text. 1/4 nat. size.

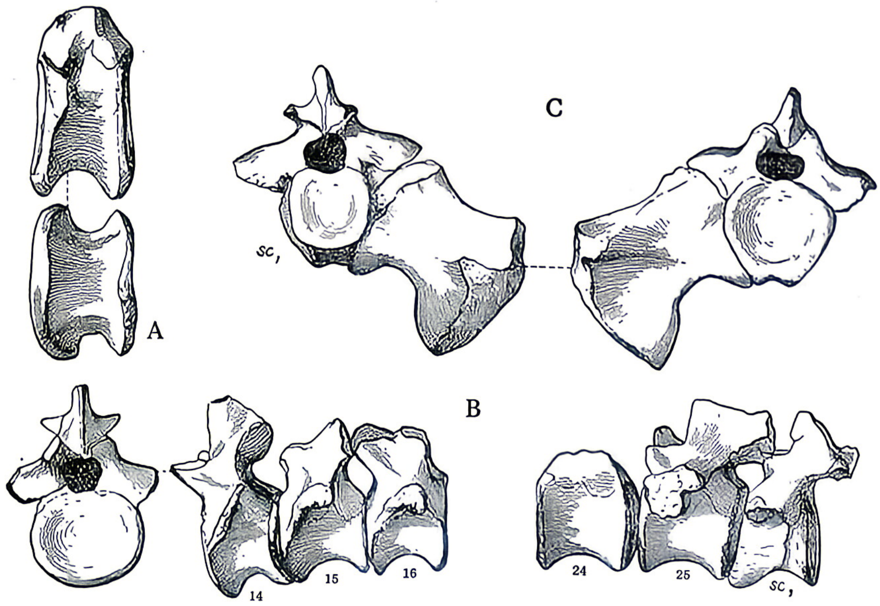


图 22　山西山西鳄,新属新种

黑峪口(60116)的一些脊椎骨。詳看正文。均原大四分之一。

Fig. 22 *Shansisuchus shansisuchus* gen. et sp. nov. A. 9th or 10th vertebrae; B. 14th to 16th and 24th to first sacral vertebrae in side views with the ventral view of A and posterior view of 14th; C. the first sacral vertebra with the first sacral rib in natural connection in two views. All from Heiyuekou (60116). 14—24. supposed number of position in the column. $Sc_1$. first sacral vertebra. All 1/4 nat. size.

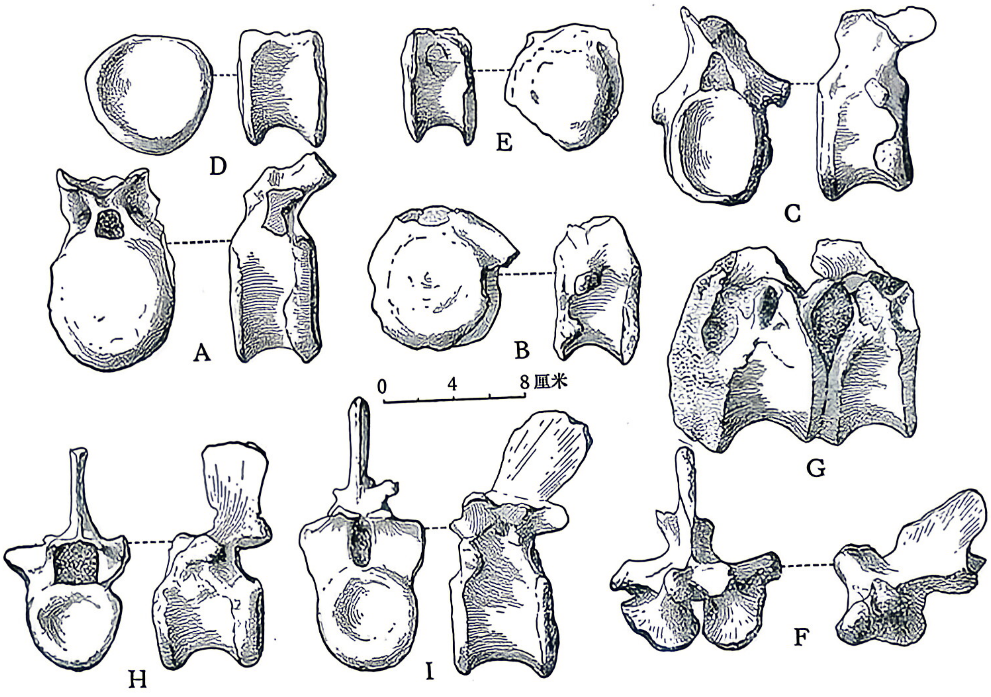


图 23 山西山西鳄,新属新种

A—C. 前部背脊椎; D—G. 背中部脊椎; H—I, 背后部脊椎。詳看正文。原大四分之一。

Fig. 23 *Shansisuchus shansisuchus* gen. et sp. nov. A few anterior (A—C) middle (D—G) and posterior (H—I) dorsal vertebrae. For details see text. 1/4 nat. size.

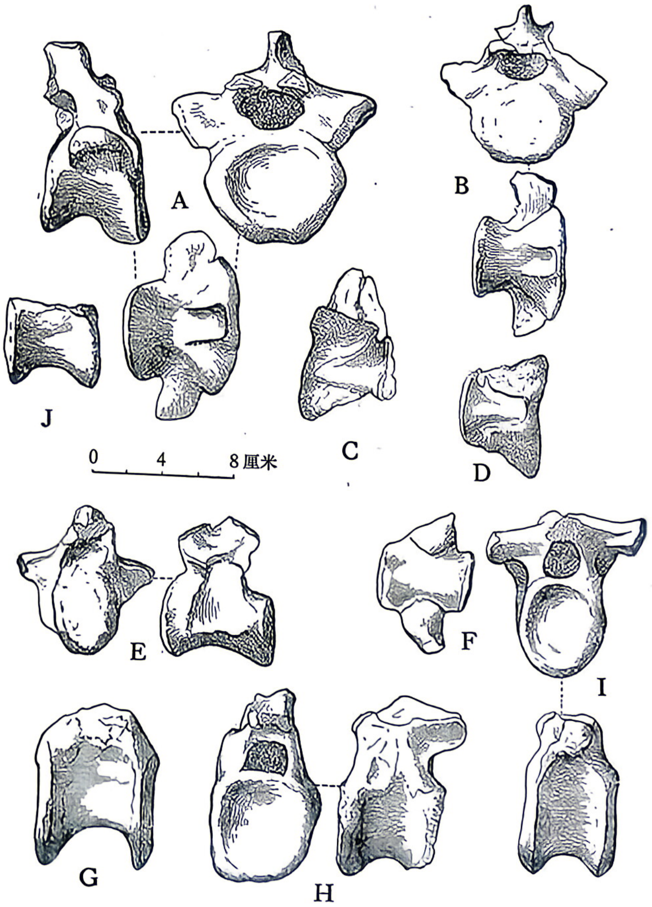


图 24 山西山西鳄,新属新种

A—D. 第一荐骨脊椎; E—F. 第二荐骨脊椎; G—J. 尾前部脊椎; 各面观。原大四分之一。

**Fig. 24** *Shansisuchus shansisuchus* gen. et sp. nov. A—D. first sacral vertebra in different views; E—F. second sacral vertebra in anterior, side and ventral views; G—J. anterior and middle caudal vertebrae in lateral views. 1/4 nat. size.

和第二十五)。第一个脊椎的性质和V. 2501所描述的相近地位的脊椎,完全一样。但是比起以下几个脊椎来,好象比較大一些。但是这个脊椎和其他标本在一起归于同一个体,似无何疑問。以下的三个脊椎的椎体还相当之短。椎体突也很短。腹侧是平滑的。椎体突位置很向上而不很显著。前关节突只稍微伸出椎体前緣一点。所有这些性质都表示这三个脊椎是属于背中部的脊椎。荐骨前的两脊椎,显著地伸长,只有最后一个还有神經弧部分保存,但是背棘已损俟。椎体突短而粗。荐骨第一脊椎也大致如此,将于以下描述。

把以上两地点的背脊椎弄淸楚以后,我們对于56173地点的大量的零散背脊椎,可以有些比較淸楚的概念。虽然在多数情况下,我們不知道每一脊椎在脊椎的行列上的确切位置,但在大多数情况下,可以知道大体上相对的部位。一般說来背前部一些的脊椎比較短,腹側較平,只部分地有中脊稜。沒有很明显的圆形椎体突。中部較前的背脊椎椎体較长,其椎体突已分化为淸楚的圆疤,位于較近椎体前底部处。自此以后,椎体也还較短,但椎体突大大向上推移,大多数在椎体以上仅有,椎体保存,就看不見。一般来說,愈向后,椎体愈长的趋势是十分淸楚的。最后背后部的腰部脊椎都是椎体比較长,沒有椎体突的痕迹。腹側較平,但有时也可有极弱中稜。腰部脊椎大体上为七个或少一些。关于背脊椎的数目,并不能十分肯定。最可能的数目为十五或至多十七。这是假若荐脊椎前的数目为二十五个,象多数槽齿类那样,那背脊椎的数目,主要由頸脊椎的数目来决定(图23)。

**荐骨脊椎I和II**:荐骨脊椎I和II都有不少完整的标本,但沒有两个是自然的連在一起。荐脊椎I的大小变化很大。它的前端宽度大于高度,呈微凹状。后端寬度和高度約相等,也作微凹状。和荐肋骨下端接触下边大大地伸出于椎体面以外。椎体突坚实而短。有两个标本,背棘局部保存,看来不会太长。荐脊椎II也大小差别很大,前端比后端只稍微大一些。两端几乎是平的。多数的这一脊椎腹侧是平的,只有一个具有微弱的中稜。和肋骨接触的面是微凹的,也很大,向下伸到脊椎的腹面相当部位。有一个标本,还部分地和肋骨相接。

**尾脊椎**:很不容易估計有多少尾脊椎。照許耐所描述的引鳄,其复原图上所示,大約为四十五个上下。但在图版8所示的照相来看,似乎少一些。作者有这么一个想法,就是象山西山西鳄这末庞大的体驅,似乎尾巴不大太长。支持这个假定的是我們所有的尾脊椎非常之少。和差不多二百个上下的荐骨前脊椎相比,我們只有四十五个上下的尾脊椎,不及四分之一。所有尾脊椎都是零散发見的。其彼此連接关系很不淸楚。象引鳄一样,尾前部脊椎的椎体,是十分收縮的。两端从微弱的双凹式到双平式。前者为尾前部的脊椎,而后者为較后部的。脊椎椎体的腹面較窄扁,有时还有中稜发育。脊椎两端的边緣相当薄而一致,表示腹棘并不太发育。只有少数脊椎尙有神經弧保存。椎体突看来短而又小。所有的尾脊椎都属尾前部或中部,尾末端的脊椎,看来并未保存多少,甚至全俟。

**肋骨**(图25):肋骨大多都很破碎,只有极少数保存較好。因为在材料中不止一种,所以有些破碎的肋骨,不能确定到底属于那一种。

沒有发見可靠的属于頸部的肋骨。

宁武孙家沟(V.2501)有一条完全的左肋骨,大概属于第九或第十荐骨前脊椎(图25j)。肋骨小头(capitulum)小而短,肋身相当之直,其中部前面有一微弱的沟。内后侧凹入,在近末端处稍为加粗,切面近于圆形。总长480毫米。結节(tuberculum)与肋骨小头之間距为88毫米,中部宽,26毫米。因为这一条肋骨属于比較大的一个个体,所以我們可用作区分肋骨的一个参考。

其他肋骨見图25 K—V。其中有些可能属于背部較靠前一些的如K、P、R和T等,其他当較靠后一些。愈向后,肋骨小头,愈为变小,而且距瘤形头为近。到最后完全消失。以下要描述的汾河鳄大小和本种差不多。所以很难区别其肋骨。但很可能肋骨較扁平而中部沟較深的或可能归于后者(如K),另外有一些很小的肋骨如图25 L、M、N等,也可能属山西鳄的另外一种——黑峪口山西鳄,将在以下描述。

在所有观察过的肋骨中,沒有很淸楚的具有第三关节的肋骨,象武氏鳄那样。只有图25 V可能为一例外。这一标本很小的那突起可能为第三关节,但眞正的結节,却沒有痕迹。很可能这只是一个发育不正常的肋骨。

沒有淸楚的尾部肋骨,另有一些破碎的棒状骨可能代表腹肋。

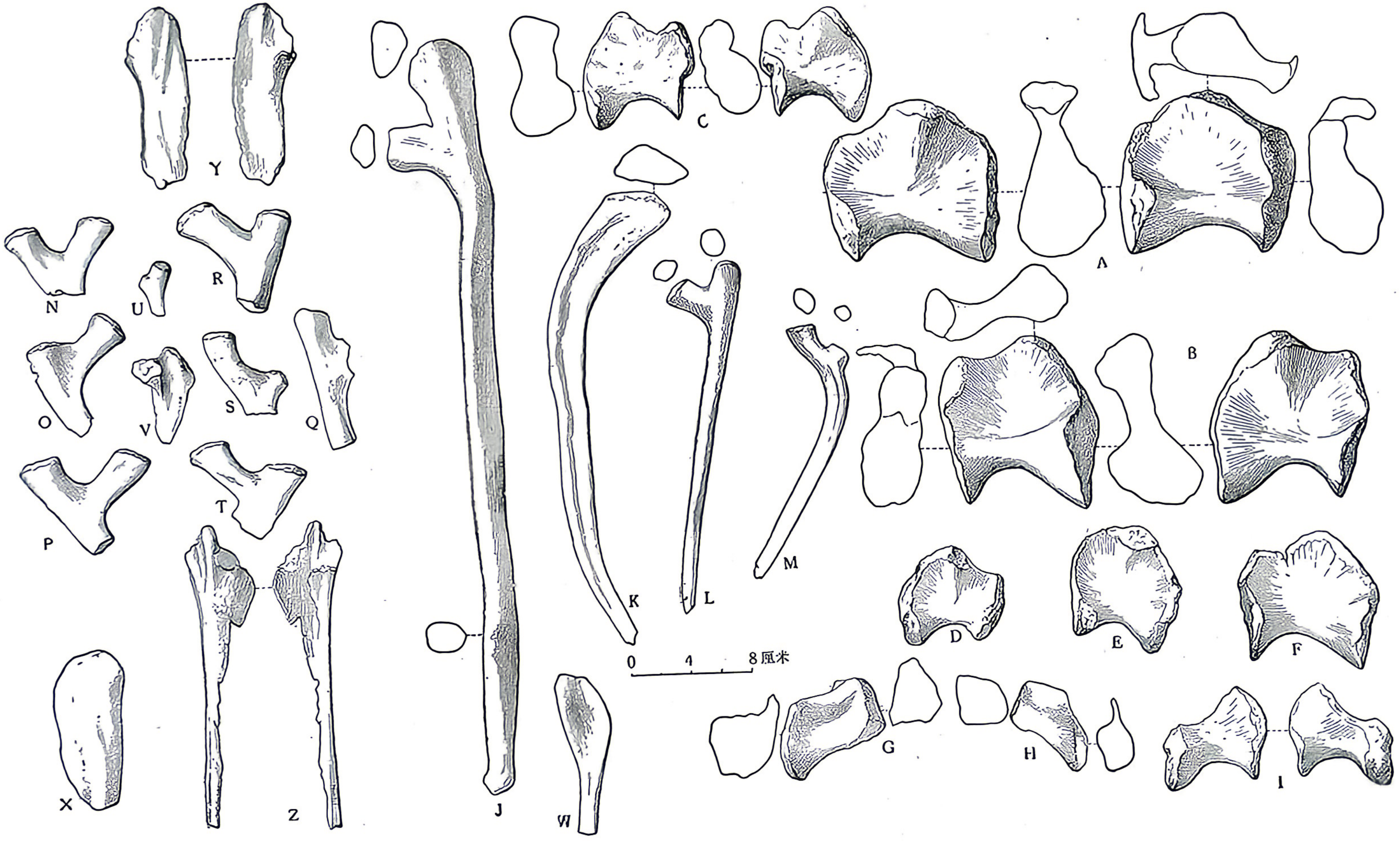


图 25　山　西　山　西　鳄，新　属　新　种

A—F. 第一荐骨肋骨；G—I. 第二荐骨脊椎；　J—V. 肋骨；　W 和 X 可能为鎖骨；　Y—Z. 間鎖骨各面観。詳见正文。原大四分之一。

Fig. 25　*Shansisuchus shansisuchus*. gen. et sp. nov. A—F. first sacral rib (A, left; B, right; C, left; D, right; E, left and F, right) in anterior and posterior views and A—C with the outlines of the connecting ends; G—I. the second sacral rib with outlines of both ends; J—V. various ribs (some are doubtfully referred here and may belonging to other form); W and X. probably proximal end of clavicle; Y and Z? interclavicle. For detail see text. 1/4 nat. size.

**荐骨肋骨 I**: 此为較厚的骨,約呈四方形(图 25, A—F)。和荐骨脊椎接触的这一边,比和腸骨接触的那一边短一些,可以分作两部分。这两边可分的两部分的接触面,成一鈍的角,恰可以适合于同荐骨脊椎 I 和腸骨对着的面。两端都加厚,所以整个骨的中部較薄,前后也微微凹入。肋骨的上外面近于直的或微向內凹入,骨面很粗糙。在活着时候或者附有軟骨組織。內下边却完全是光的而和外上面相反,比較深地凹入。荐骨肋骨 I 大小差別很大,但一般性质非常相似。图 22 C (60116) 所示的肋骨 I 关于上述的各关节面的加厚特别清楚,其大小介于許多标本之間(另外不能完全排除这一可能性, 就是有若干特小的可能归于下述的小的山西鳄)。

同比較丰富的第一荐骨肋骨相反,第二荐骨肋骨,很有可疑。事实所有荐骨肋骨 II 都是零星找見的, 未和有关的脊椎或者腸骨相連接。有几个零散找見的骨被当作第二肋骨, 其大小和細微构造, 很不相同 (图 25, G、H 和 I)。較宽較长的一面,当作是連于腸骨的,而另外一端較粗較呈圓三角状的一端是和第二荐骨脊椎相接的。以上所說和腸骨接的一端,比較上适合于腸骨后部的槽状痕迹。

关于脊椎骨和肋骨的尺度見表 6 (頁 135)。

## 肩 带 与 前 肢

大多数属于肩带和前肢的骨骼都属于这一种。只有极少数的若干,可以当作是以下要記述的属种。 有些骨骼,其关节处很薄,也瘦小一些,可能是年輕的个体,而沒有系統上的价值。

**肩胛骨**: 若和引鳄或武氏鳄相比,我們所有的肩胛骨可以立即与之区别。主要是当中收縮的很厉害,而使得末端特别显得宽一些。在成年的个体,肩胛骨的近端关节部分,非常之厚,比烏喙骨边緣厚三倍以上。烏喙骨边緣上部比較凹入。然后比較驟然收縮,但很快的就朝末端开始变宽。 所介于近端下前角和远端上前角之間的弯度几乎成为半圆状。肩胛骨的后边比較直。只是在和肱骨关节的上部突出地向后伸出一些。在成年个体,肱骨关节的面相当的厚。年輕的标本,关节面中部稍有凹入。有些标本, 近端比远端稍窄一些或者大致相等,認为是这一种肩胛骨的特征之一,和烏喙骨接触的面为三角状輪廓。由此逐漸向前变直到和鎖骨接連的地方。肩胛骨的远端作平板状,但在成年标本,也稍微加厚一些。由前边看, 肩胛骨在收縮的地方向外微微弯曲(图 26, A—E)。

**烏喙骨**: 烏喙骨和引鳄的同一骨非常相象。大致輪廓作三角状,其下腹側一边为圓弧形。 和肩胛骨接触面与和肱骨接触面都很厚,以与肩胛骨相符合。下腹側一边也比較厚,但驟然地向前变薄。烏喙骨的外面相当平而內面比較深凹。烏喙骨孔很发育,比較为小,位于距肩胛骨边下約 20 毫米处。但在內面,一直通到边緣,也不太显著(图 26, A、F)。

象以前所指出的并不是在所有情况下, 都可以区别肩胛带的骨骼, 归于其他种的这一类骨将于以后叙述。

**鎖骨与間鎖骨**: 关于这两个骨的是否存在,以及是否属于此种,都还是十分可疑的。 但是图 25 所示的 W 和 X 两标本,似乎代表鎖骨的近端部分。这两个骨都不象武氏鳄的那末弯曲。图 25 X 較大也較平 (地点为 56156, V. 2496),但其大小似与山西山西鳄相仿。另一标本(25, W)較小也較薄,內側也較凹入。这个标本,可能属山西鳄属的另一种,或者是一幼年个体。

图 25 Y 和 Z 所表示的两标本,当代表間鎖骨。后部损坏,前边也稍损伤。把这两骨归于山西鳄,只是初步的安排,因两骨对山西山西鳄来說都未免太小一些,除非也是归于幼年个体。特别是标本 25 Z ,其后部保存較多,更应如此。特别值得指出的,也是可以令人怀疑到底是不是間鎖骨的一点, 就是骨的前端外側反折状两边不对称。前端后的收縮非常輕微向后逐漸加宽。

**肱骨**: 大多数的肱骨,无疑归属这一种。肱骨的两端彼此扭折的程度不大, 約为三十度。 眞正短的干部,也是比較的扁平。整个骨的最窄狹部分約位于全骨的中間,或者稍微靠下一些。 肱骨的近端相当扩展,其三角稜很向下垂,距骨的中部以上不远。在属于成年的标本,关节部分相当显著地加厚。特别沿三角稜部分,肱骨的近端作弧形弯曲。尽管肱骨末端比近端稍窄一些,但是明显地加宽。位于远端以上的前腹側一面的深的凹陷,非常显著,只有年幼的标本不清楚。沒有眞正的外髁孔存在,只有年輕的个体,在原处还殘存着

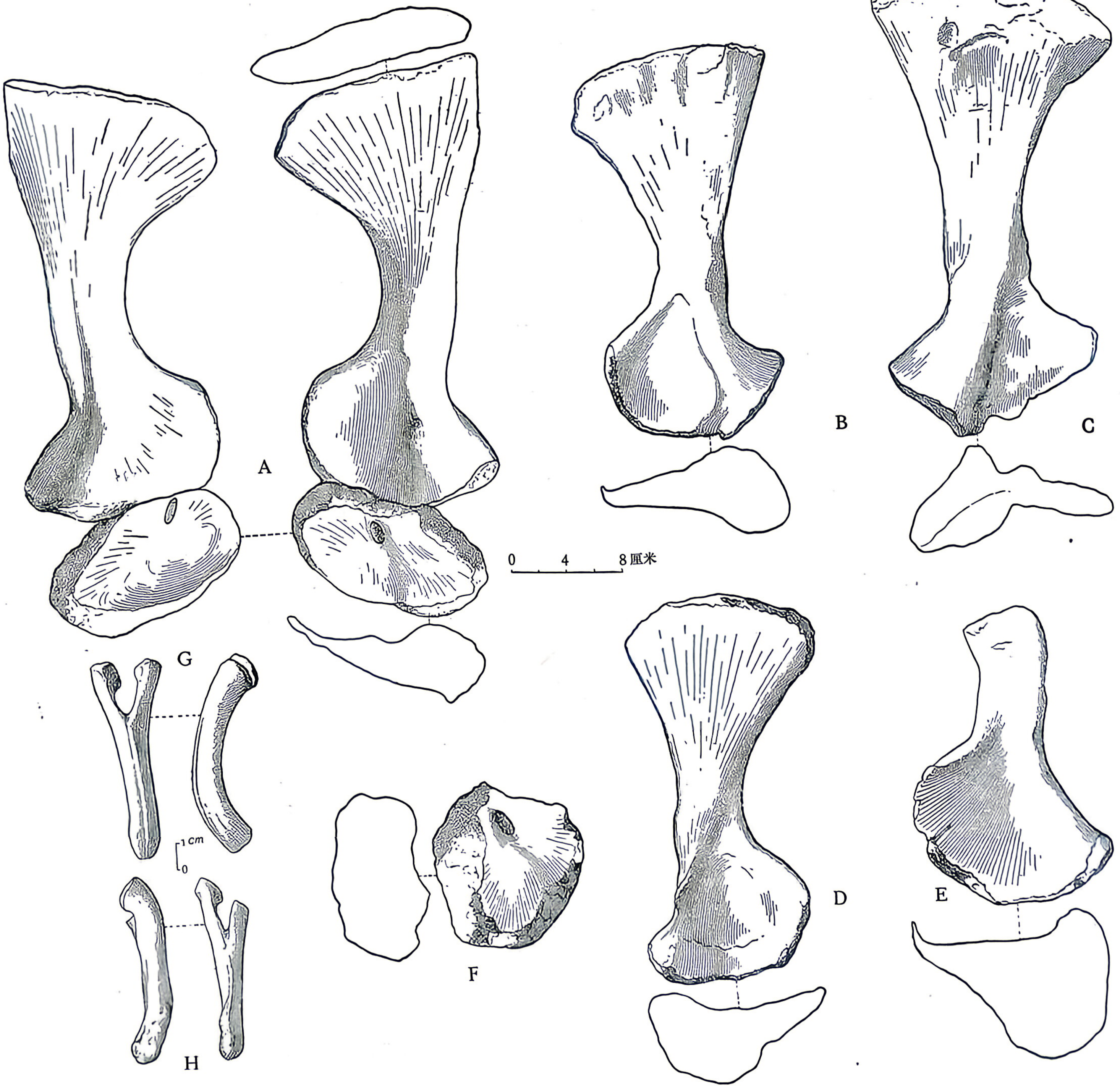


图 26 山 西 山 西 鳄，新 属 新 种

肩胛骨、烏喙骨与腹棘等。詳見正文。A—F. 原大四分之一。G—H. 原大二分之一。

Fig. 26 *Shansisuchus shansisuchus* gen. et sp. nov. A. left scapula with coracoid from Heiyuekou (60116) in inner and outer view; B. left scapula in lateral view; C. right scapula in lateral view; D. right scapula in lateral view; E. proximal part of left scapula in lateral view; F. coracoid in external view. Note the difference of the thickness proximal glenoid end 1/4 nat. size (A—F). G—H. two chevron bones from NWC E. D, probably belong to this species, 1/2 nat. size.

一沟状遺痕。在年輕的标本，关节部分不显著，骨也比較薄。但一般的形状和上下两端扭折程度完全一样，所以归于同一种是无疑問的。总的說来，山西山西鳄的肱骨，比較易于从其他种类区别，比起引鳄和武氏鳄来，三角稜不特别下伸(图 27，A—D)。

**尺骨**：在所有材料中，尺骨非常之少，只有三个完整的标本，其余都是些破碎的两端。虽然三个完整尺骨，很难断定属于那一个个体，但我們的尺骨在比較上比引鳄和武氏鳄为短，这一点非常清楚。在这两已知假鳄，尺骨只稍許比肱骨短一些，而在我們的标本，其长度几乎还不到肱骨长的三分之二。沒有清楚的肘突

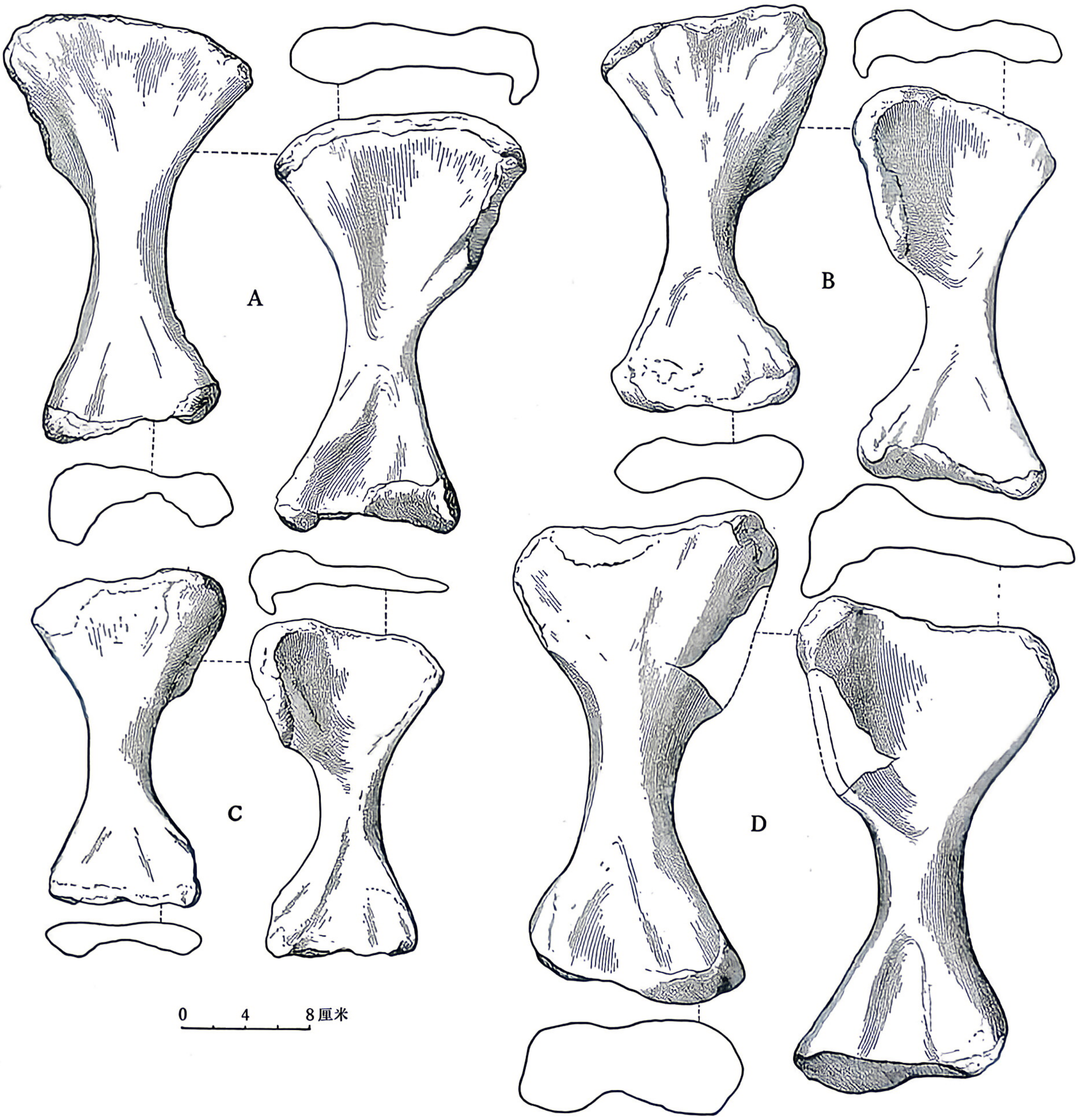


图 27　山西山西鳄，新属新种

肱骨。詳见正文。原大四分之一。

Fig. 27 *Shansisuchus shansisuchus*. gen. et sp. nov. A. left; B—D. right humeri; D. from Sunchiakou (V. 2501) in ventral and dorsal views with outlines of both ends. 1/4 nat. size.

存在的痕迹。近端相当的粗,其輪廓为三角状,稍微凸出或近于平的。近端面的形状,有时有些差别,主要由于后內尖伸出的程度而不同。尺骨由近端起开始向远端变窄变薄,其最細的地方位于相当近于远端的地方,然后逐漸又加粗,成为坚实的远端。其輪廓近于圓形。 因尺骨收縮的地方非常的薄, 所以很容易从此处折断。总的說骨干是比較直的,但在未成年的标本,可以有輕微的弓形弯曲(图 28, A—B)。

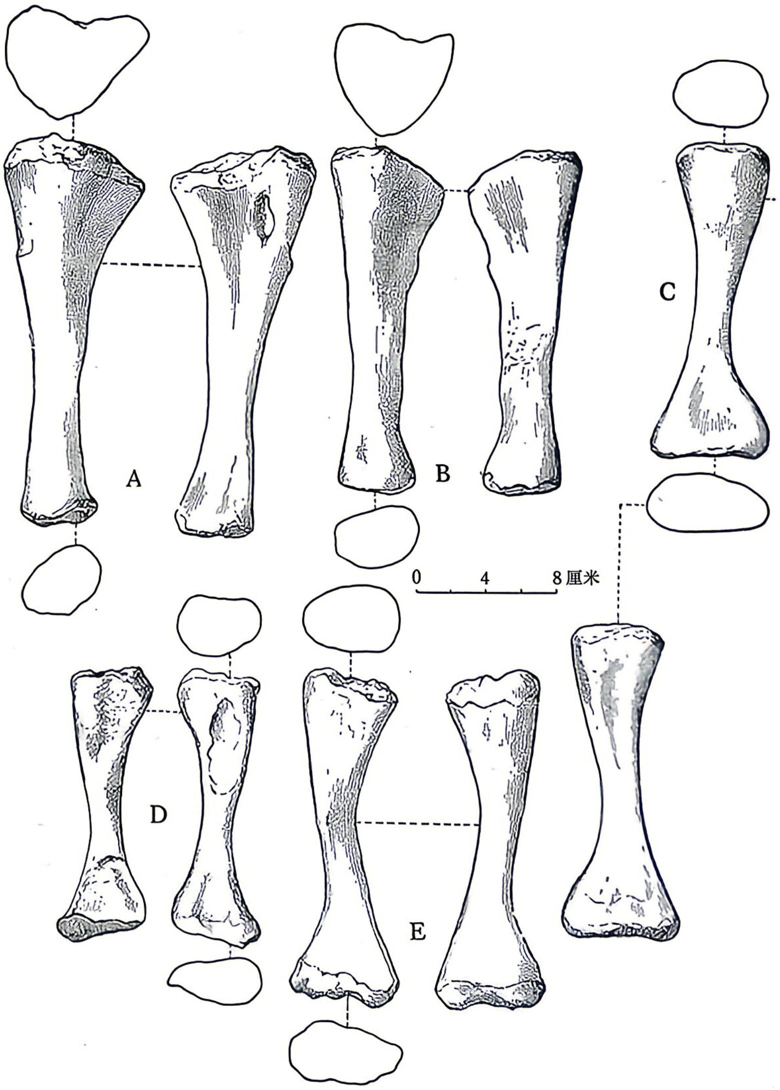


图 28 山西山西鳄,新属新种

A—B. 尺骨; C—E. 橈骨。詳見正文。原大四分之一。

Fig. 28 *Shansisuchus shansisuchus*, gen. et sp. nov. A—B. ulna; C—E. radius in two views with the outlines of both ends. For details see text. 1/4 nat. size.

**橈骨**: 橈骨的长度和尺骨差不多,或者比之較短。它的近端作椭圓状,也相当的粗。最細的地方位于骨干約当中地方,微作弓形弯曲。橈骨的末端比較扩展。大多数破碎的两端表示大小差别很大,主要由于年龄不同(图 28, C—E)。

关于肩带和前肢的大小見表 7 (頁 137)。

## 腰 带 和 后 肢

虽然只有少数是完整的,但腰带和后肢各部分均有其代表。关于腰带, V. 2501 与同一号碼的头骨为一

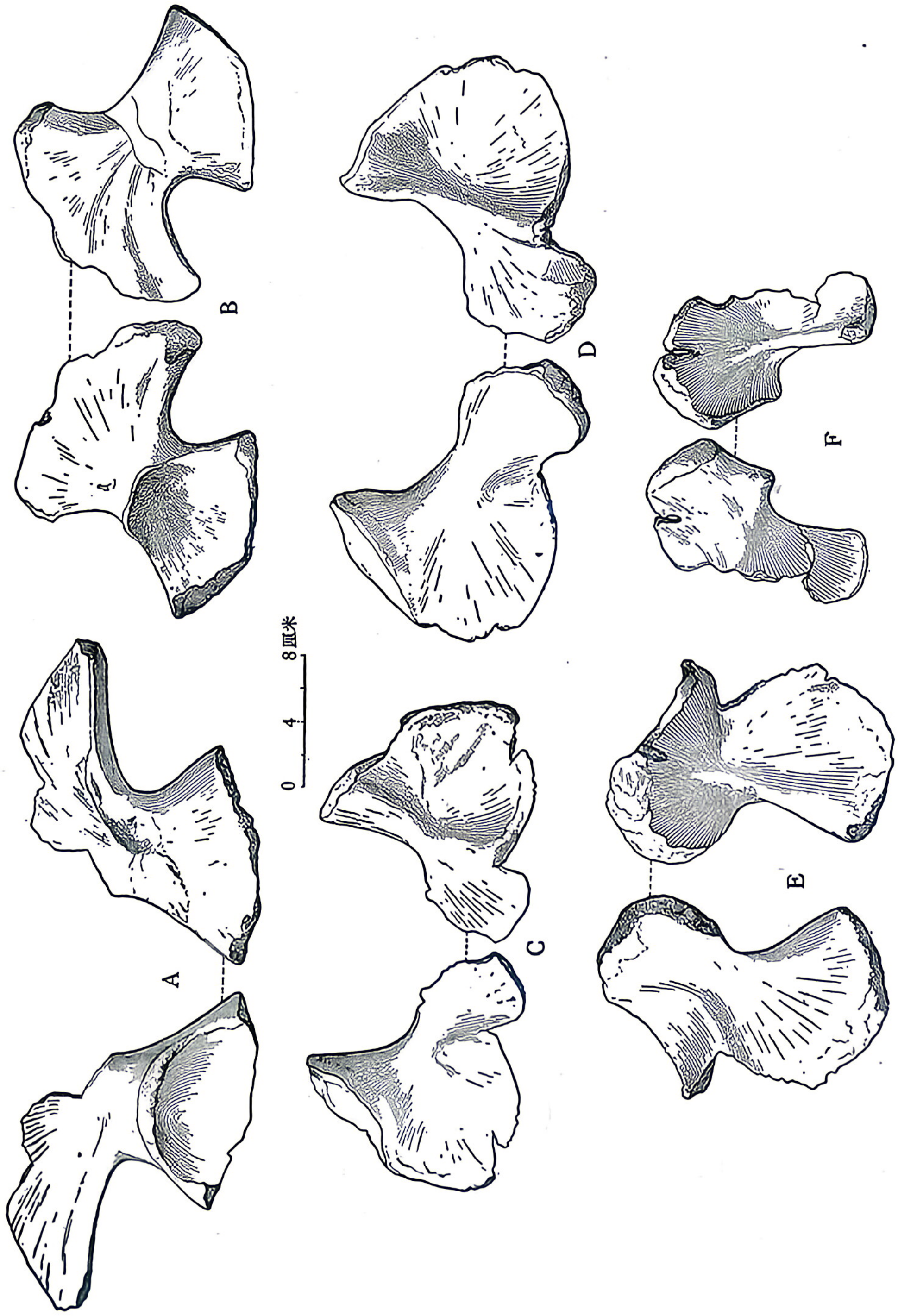


图 29　山西山西鳄，新属新种

A—B. 髂骨；　C—D. 坐骨；　E—F. 耻骨。详见正文。原大四分之一。

Fig. 29　*Shansisuchus shansisuchus* gen. et sp. nov. A—B. ilium; C—D. ischium; E—F. pubis in two views. For details see text. 1/4 nat. size.

个个体，且最完整(图 29—30)。

**腸骨**：山西山西鳄的腸骨和引鳄的腸骨，非常相似。向前伸出部分非常微弱，几乎沒有超出髋臼前緣以外，至于向后伸出部分，非常的长，具有棒状的末端。介于前和后的腸骨的上緣，呈一微弱的弯曲状，但最后部十分伸出。髋臼似乎封閉(討論見下)，其上边具显著的稜状向外作簷状伸出。和恥骨相連接的边緣，比和坐骨相連接的边緣，长出很多。两者成一很大的鈍角。在內側一面，相当于髋臼部分，比較凸出。在內側第一和第二肋骨所留的印痕，一般地非常清楚。第二肋骨的印痕开始处比第一为高，然后后变窄，以至在腸骨向后伸出部分边緣之上消失。髋臼和腸骨板之間的收縮寬度約等于和恥骨接触的边緣。腸骨板本身，大部分很薄，所以易于破碎。有几个腸骨，髋臼构造非常特別，显然属于另外的种类，将在以后敘述。总的說来大多数腸骨，都可列入山西山西鳄一种。

**恥骨**：恥骨的构造也和引鳄的恥骨很相似，至少在一般的构造上。但有一显著的区別，就是山西山西鳄恥骨的恥骨孔非常靠近边緣，只是作为通向坐骨边的一个"缺口"。这个孔几乎沒有封口，而是清楚的隔开的。在引鳄和武氏鳄两属，恥骨孔完全封閉，也距坐骨边相当之远。在自 56173 地点所得材料中，只有一个

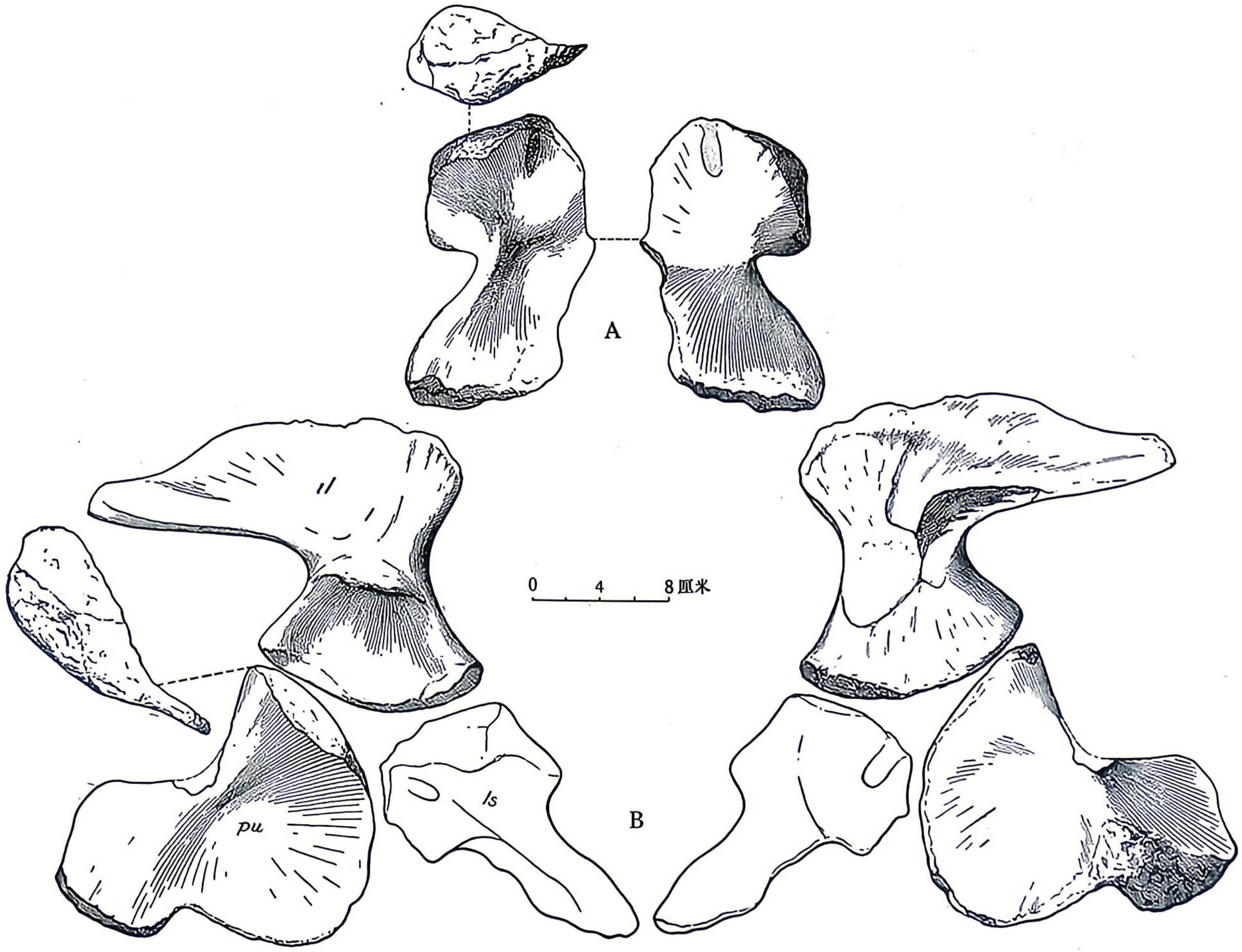


图 30 山西山西鳄，新属新种

A. 左恥骨，双面观与近端观；B. V. 2501 的腰带骨复原(恥骨根据 56173 标本)。詳見正文。原大四分之一。

Fig. 30 *Shansisuchus shansisuchus* gen. et sp. nov. A. left pubis in two views with the outline of proximal end; B. a tentative reconstruction of the right pelvic girdle in lateral and inner views. The pubis missing, based on the other specimen from 56173. The pelvic girdle is the same individual as the skull and vertebrae etc. from Sunchiakou (V.2501). 1/4 nat. size.

耻骨，其耻骨孔是封閉的(見下)。因为絕大多数耻骨孔靠边緣，而不封閉的耻骨都未完全封閉，V. 2501那一完整腰带的耻骨也是如此(此标本与V. 2501头骨同一个体，无疑地属于山西山西鳄)。我們觉得这一类耻骨应当归于山西山西鳄，而具有封閉耻骨孔的才归于另外的假鳄类。

耻骨特别短。其长度只多出宽度有限。只有一些属于年輕个体的标本（也可能归于另种）才稍微长一些。同腸骨接触面，和同坐骨接触面的部分，形成耻骨的近端，非常之厚，为全骨最厚部分。至于同相对的另一耻骨接触处，比較很薄。耻骨的远端，作断切状或稍作弯曲。在耻骨的中腰处，有一些輕微收縮而变窄，并向坐骨边成直角弯曲。在上述收縮处以下，耻骨成为平板状，其后外角处，相当的厚。介于耻骨两端間，全骨作特殊的拱曲，所以前外面凸起，而內后面凹入很为突出。有些属于年輕个体的标本，可以看見有一稜状体介于远端的內侧和耻骨孔后部之間。

**坐骨**：坐骨也和引鳄的坐骨相似，而和武氏鳄的不大相近。这个骨短而宽。在成长完全的标本上，可以辨認出和腸骨接触的面。这个面和眞正构成髋臼部之間，往往为一不太显著的稜所隔。整个的面作新月形輪廓。整个坐骨在近端以下为平板状，向前向內侧作半圆状弯曲伸长。在此处驟然收縮，成为明显的缺口，約位于全骨总长的三分之二部分。这个构造和引鳄完全相同，而在武氏鳄极不清楚。从外侧看，这缺口向后向上形成一沟状凹陷。在这个沟以后，另外还有一个較浅的小沟，有时可以看到。这情况特别在成长的个体的标本，更为清楚。坐骨的远端或多或少地加厚一些，并且末端很鈍。从內侧看，近端和远端之間的部分，形成一浅的凹面。但为外侧有上述斜沟的部分所形成的稜隔开。所有这些从56173地点发見的坐骨的性质，完全和自宁武孙家沟(V. 2501)的坐骨相同。因此我們認为都同归一种是无可置疑的。V. 2501的腰带代表一大而成年的个体。因之上述的外面的沟不很显著。

**关于腰带的再造**：除了采自宁武孙家沟(V. 2501)的右腸骨、右坐骨和左耻骨，的确属于一个个体外，沒有任何两个属于腰带骨在自然相連的情况下找見。由于这个相連接的标本，使我們可得整个腰带骨的形象，如图30 B所示。由这个图可以看出，尽管总的說来，我們的山西鳄腰带，和引鳄的很相象，但也还有一些相当重要的区别。山西山西鳄的前端几乎是无足輕重的小，很有些象武氏鳄的腸骨。而耻骨接触面，比較上为小，和坐骨接触面所成的鈍角，几乎为一連續的弯曲，而不易找出其区分点。耻骨和坐骨都比較短。耻骨孔靠近边緣，而且具有缺口。除此以外，耻骨和坐骨的长相差不多，几乎相等，远比腸骨从前端到后端的距离为短。此在引鳄和武氏鳄則恰恰相反。象在同一图上所表示的，耻骨和坐骨对于构成髋臼来說，在比較上只占一小部分(比三分之一为小)。腸骨和两骨相連接地方，如上所說，为一連續的弯曲，而非如其他种成直角状。接耻骨的一边比較长一些。具有兴趣的一点是，如同一图所示，并且为在装架V.2501，56173（V. 2503）和同一个体60116（V. 2513）等骨骼时所証明的，腰带的三个骨，不能很自然地接合在一起。必須指出，許耐（1911, p. 22，图10）所作抄自步龙关于非洲引鳄的再造图可能有些主观成分。因为同一种装架起来的骨(ibid., Pl. VIII)髋骨部分也沒有封閉。因此我們山西山西鳄的腰带髋臼，极可能是不十分封閉的。无論如何，这个新种的腰带各骨具有明显的，自己所具有的特性，和其他有关的属，都有一些区别。

**股骨**：同肱骨一样，股骨有許多年龄不同的标本，因而在細节的区别上不很相同。一般地講来，年紀較輕的个体，其股骨的两端关节处比較上或者很薄，骨身也瘦弱一些。从60116地点(V.2513)的左股骨和右股骨的两端，当为比較成年的个体，其一切性质和56173地点保存好些的股骨；十分相近似(图31)。

和引鳄一样，股骨的两端关节面上具有一沟，有的清楚一些，有的不很清楚，当由于年龄关系。此說明当动物生存的时候，上面蒙有軟骨組織。比較起来，我們的标本，不如引鳄的那么显著。在我們的标本中，年輕一些的标本，沟特别清楚，成年的差一些，但大多数均或能看見其存在。只有极少标本，沒有沟的遺迹可寻。整个股骨相当的直，沒有“S”状的弯曲。骨的两端，只比較微为加宽。在成年标本，近端比远端稍宽一些，而在年輕的标本可以相反，远端較宽。和以后所要叙述的种比較起来，股骨的两端稍有扭折，至多約30°度。同大的腰带的髋臼比起来，股骨的近端关节，显得很小，但都或多或少地形成。股骨的关节向侧面逐漸变窄，和不十分显著、发育很差的小轉节(lesser trochanter)相連。在年輕的标本，股骨上端的两边，或多或少的有些凹陷。第四轉节，不很发育。但在多数情况下，可以辨認出来。第四轉节的位置，离近端不很远，在整个骨干中点以上有相当远的距离。股骨的最窄狭处，位于骨干中点的較下一些，向左右方稍扩展一些，那就是說左

右比前后的宽度为大。一般說来远端的宽度比近端的宽度为小。但在年幼的个体，可以相反，远端宽于近端。股骨远端的輪廓作距形，但在比較不成年的一些标本，和脛骨接連的那一关节比較上向內伸出。在远端紧边上，骨的前后部有一相当发育的凹陷面，此在年幼的标本，特别显著。远端內边和外边，可能有一微弱的沟，但在成年的标本，几乎完全消失。

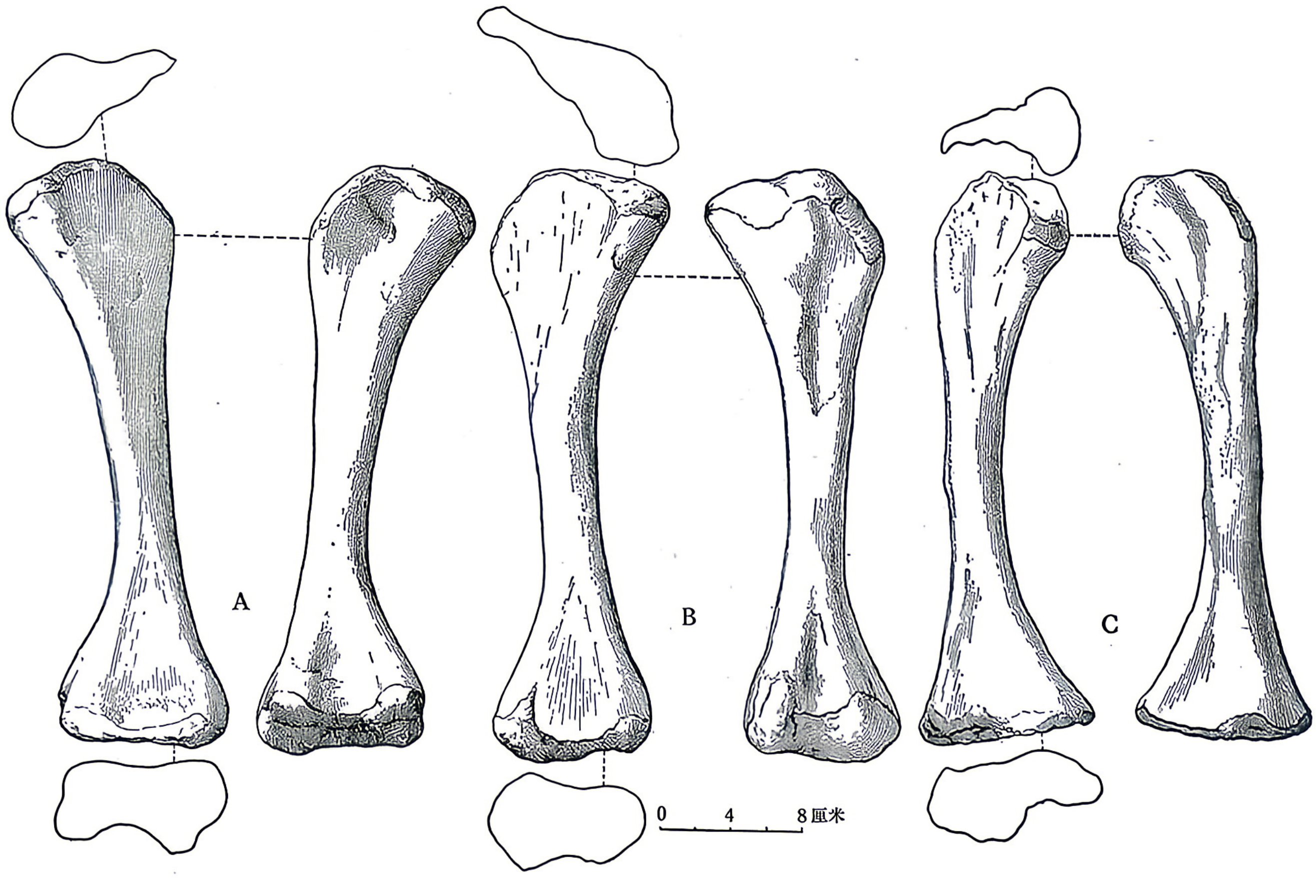


图 31　山西山西鰐，新属新种

A. 左；B—C. 右股骨前视与后视。詳看正文。原大四分之一。

Fig. 31　*Shansisuchus shansisuchus* gen. et sp. nov. A. left; B. and C. right femora in anterior and posterior views with outline of the both ends. 1/4 nat. size.

**脛骨**：脛骨保存很差，大半只有两端，只有两个完整的标本(56173)。脛骨的近端相当的粗大。其近端的輪廓作圓角三角状，向前伸的一角(cnemial crest)非常之鈍。近端面在內側部分很高，然后向外側坡下。在近端的外側下面，有一显著的凹陷面。但在其他标本多不那么显著。由骨的近端起，相当驟然地朝远端加窄，但随即逐渐地变粗，而成为一段較細的骨干。在此部分有些左右压扁的趋势。自此起骨干又稍加宽，而成为一較宽的远端，当然其扩展程度比近端差的多。远端的輪廓为横的扩展的椭圓面。总的說来，脛骨不是很碩大的，和武氏鰐的脛骨可以相比。沒有一个脛骨和股骨一块发现过，因此两者的长短关系不可能知道。但是如果我們将大致年龄相同的股骨和脛骨比較一下，就知道脛骨远比股骨为短，比以上所提的武氏鰐短的多(图 32，A—B)。

**腓骨**：同脛骨一样，腓骨也很細小。腓骨多少作“S”状弯曲。腓骨的两端，只輕微的加宽，而且大致相等，在比較上远端稍为粗大一些。年輕个体的腓骨，非常之薄。腓骨的內面有一浅沟向两端逐漸消失。外側发育很差的凸骨，大致位于骨干中間的較下边。因为沒有一个腓骨和脛骨或股骨一起发现，其相对长度也不

能肯定。但是很可能比脛骨稍长一些。从宁武孙家沟(V. 2501, 图 32, C)所采的腓骨，是我們具有的材料中最大的一个腓骨。比所有的脛骨都长的多。这一事实,或者說明,在 56173 地点,最大的个体,还沒有被发見(其他骨也說明这一点)。

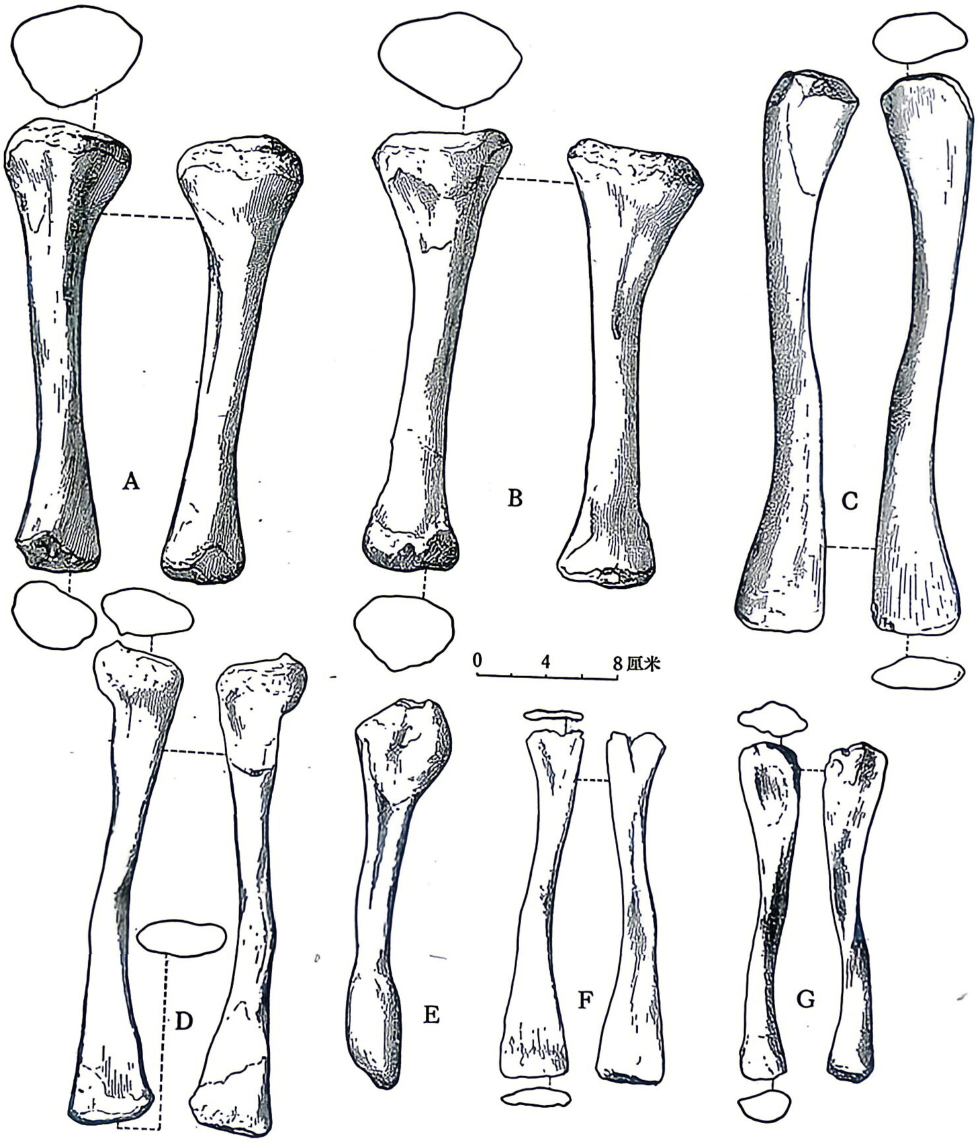


图 32　山西山西鰐,新属新种

A—B. 脛骨; C—D. 腓骨双面視; E. 一病态腓骨; F, G. 二未成长的腓骨。詳看正文。均原大四分之一。

Fig. 32 *Shansisuchus shansisuchus* gen et sp. nov. A and B. tibia; C and D. fibula in two views; E. a pathological fibula; F、G. two fibulae of young individual. For details see text. 1/4 nat. size.

关于腰带骨和后肢骨的尺度可見表 8 (頁 141)。

## 前 足 和 后 足

比起其他骨骼来,所有前足和后足的骨骼,都是非常少的。在将近五十个个体中，我們几乎不能凑成一套綜合的前足和后足。除了距骨以外,所有前后足的骨骼几乎沒有什么重分的。因前后足的骨骼保存很少,而且在我們的材料中,假鰐类不止一种,有的大小和这一种差不多,所以鉴定上相当困难。 以下当作是山西

山西鰐的前后足,多少有些不能十分肯定,乃是自然的(图 33—36)。

**手根骨**:沒有肯定的尺腕骨和橈腕骨发見。手根骨的远端一排,可能由有若干为之代表,有的如图 33E—H 所示。所表示的可能为掌的一面。很可能 E 为第一, F 为中間, G 为第四, H 为第二末排腕骨。所有各骨形状都不太规則,其骨化可能还不完全。

**掌骨**:除了 33D 所示,掌骨 II、III 和 IV 还附着于其指骨之上,无疑的为一个体外,其他骨均是零星找見的。图 33A 当作右 Mtc. I—V, 而当作左 Mtc. I—IV。只有右侧有 Mtc. V, 这是綜合而成的。Mtc. I 短而宽。以下的几个,也相当的宽, Mtc. V 的末端有損伤,比較細小。在所有的掌腕骨,近端都特別作横的扩展。

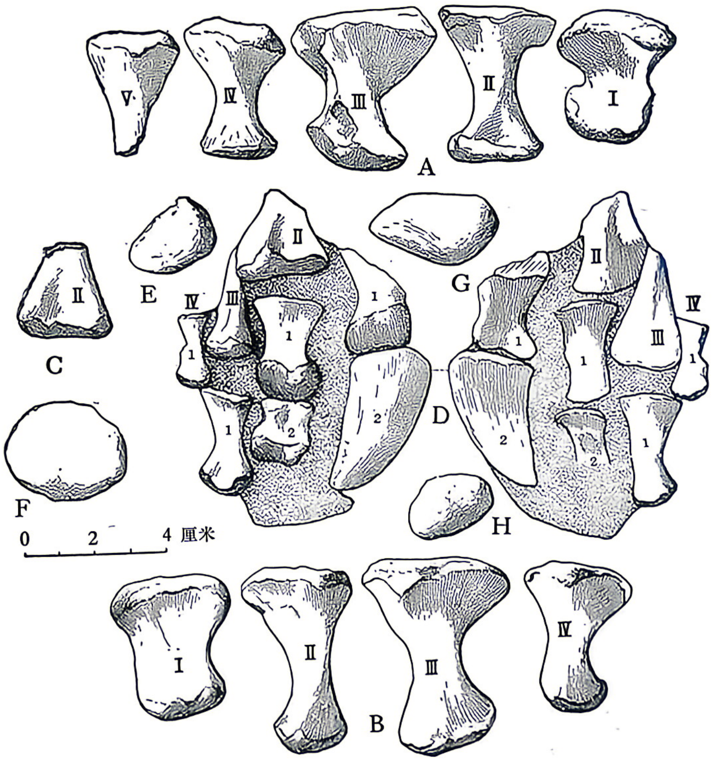


图 33 山西山西鰐,新属新种

A. 右手掌骨 I—V; B. 左手掌骨 I—IV; C. Mtc. II 远端; D. 左手双面观; E—H. 手跟骨。詳見正文。均原大二分之一。

Fig. 33 *Shansisuchus shansisuchus* gen. et sp. nov. A. right metacarpals I—V tentatively arranged in dorsal view and supposed to be the right side; B. the same I—IV of the left side; C. distal ends of metacarpal II; D. left hand bones in natural preservation in two views; E—H. various carpals of the hand, definite position doubtful. 1/2 nat. size.

**指骨**:大多数零散的指骨包括末一个(爪)在內,都看作是属于后足的,所以沒有可靠的可以認为的确属于手的指骨。但也不能排斥这一可能性,就是当作为趾骨的某些标本,或者也可能是手上的。但是在上述的标本(示于图 33D)的左手有 Mtc. I 的第一指骨,和第二指骨, Mtc. II 的第一第二指骨, Mtc. III 的第一指骨, Mtc. IV 的第一指骨。四个手掌骨的指骨从內向外,变小的很快。第一趾的末一指骨特别大而短,非常横地縮扁,而且非常之尖。其他指骨,性质一般,无何特殊叙述的必要。

总的說来,山西山西鰐的手比較原始,因为所有手掌骨都比較短,而未十分拉长。

脚上的骨骼保存的比較完全一些。

**距骨**:(图 34, A—B) 关于距骨有两个保存比較好的,示于图 34 A—B。这两个距骨,当作是属于山西山西鰐的,但其形状,有相当大的差别。尽管如此,似乎还可归于同一种。这一骨似乎应为这样的摆法,那就

是具有較凹入的一面,并且有一横的斜稜,为上边和背方的一面,而横的凸出的一面,为下方或腹方的一面。厚而較圆的一端为外側,而上下較扁平的一端为內側。前者的末端,微作凸出状,和跟骨的內側凹入部分,巧相符合。这个末端向上伸而形成一小的斜形面。此斜形面,也和跟骨相当的一面很合拍。內側的一端也稍凸出。在腹側有一明显的横沟。靠內側較平处,为和 Mt. I 接触的面,而外側的面則为接受內側远排足跟骨之用。在外側的前部,距外側很近,有一凹入面,无疑的为和跟骨前面的凹入面相对称。从后面看,第二个斜的稜,由上后外角起向內向下伸到骨的腹側以至距內端約十二分之一处。这一斜稜把外側很深的凹陷部分和內側的粗糙面部分分而为二。无論从前或从后看,全距骨的形状約为“L”形,以上述的接触較厚而高的面为頂端。这一部和跟骨相連,成为和腓骨接触处,而和脛骨接触处,則在那斜稜的內側。总的說来,距骨的一般构造似已多少具有以后原始恐龙距骨的若干性质,尽管山西山西鰐距骨的向上突起构造还相当不同。

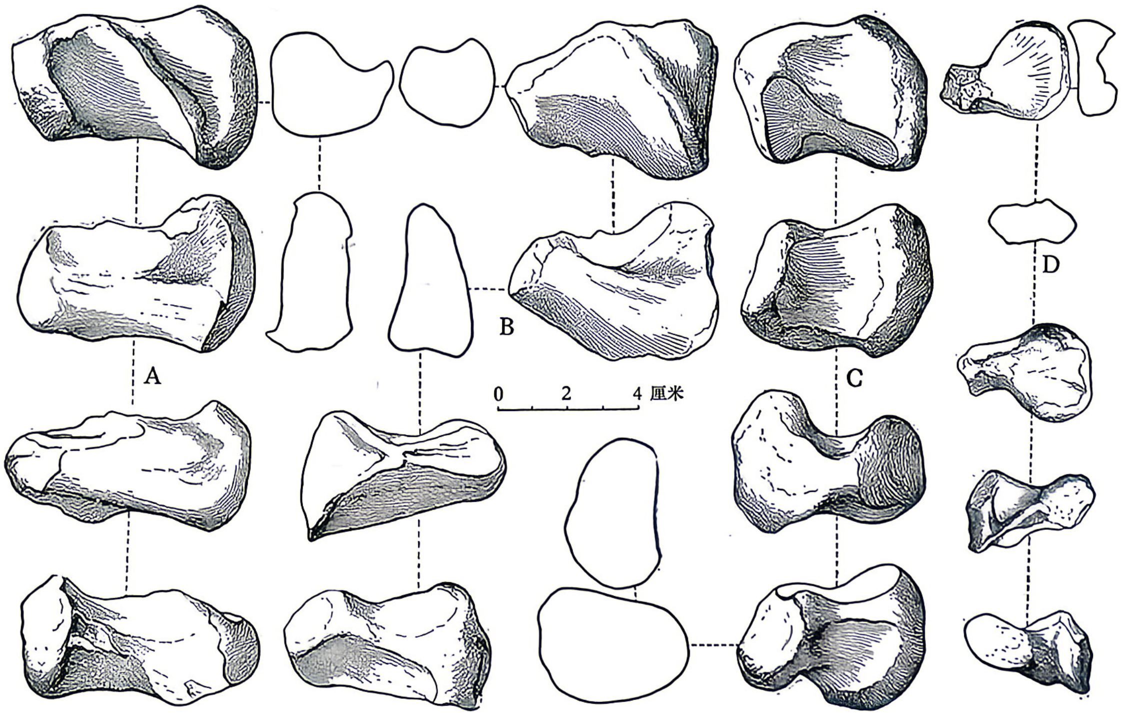


图 34　山西山西鰐,新属新种　A—B. 跟骨六面观。原大二分之一。
稜脊汾河鰐,新属新种　C. 距骨六面观。原大二分之一。
择义王氏鰐,新属新种　D. 跟骨六面观。詳看正文。原大二分之一。

Fig. 34 *Shansisuchus shansisuchus* gen. et sp. nov. A—B. astragalus in dorsal, ventral anterior and posterior views with the outlines of the both ends. *Fenhosuchus cristatus* gen. et sp. nov. C. calcaneum in six views. *Wangisuchus tzeyii* gen. et sp. nov. D. astragalus in six views. All in 1/2 nat. size.

**跟骨:** 至少有三十个以上的零散跟骨,有五个見图 35 A—E。这几个跟骨,大小与构造差别很大,但总的說来,基本形式一致,十之八九均归这一种。跟骨的摆法认为是:輕微的凹入面为前面或上面,而馬鞍状稍微凸出的一面为后面或腹面。宽而厚的一端,中部稍微凹入一些,对着跟骨的外側为內側,而另外不太宽的一端作半圆状为外側。如附图所表示,两端的宽度变化很大。距骨的上边相当之厚,而且直,为与腓骨接触处。下边較薄,有时候微微凸出。两端的两凸出部分,为和末排足跟骨外側与內側接处之处。跟骨比較小,特别其横的宽度,比距骨短的多。总的說来,山西山西鰐的跟骨为平板状,因而相当原始。它可以和原始的爬行动物的跟骨相比,如引鰐(許耐,1915,1920),而和其他較特殊化的假鰐类不相同(Sawin,1947;Walker,1961),更和近代鰐魚不相同(Schaeffer,1941)。我們所描述的跟骨,和引鰐的跟骨,特别相似,只有細微的区别,說明两者間之关系非常之近。

**末排足跟骨**：末排足跟骨有十三个，均为不规则的球状形，具有一两个較平面。也在大小上差別很大（最大直径33—62毫米）。因为都是零散找見的，不易辨別其眞实位置。但是那些比較小的可能屬于中間或較內側部分，而大一些的屬于外側。曾把其中几个作了切面，表示骨細胞組織相当致密，且有清楚的骨化中心。

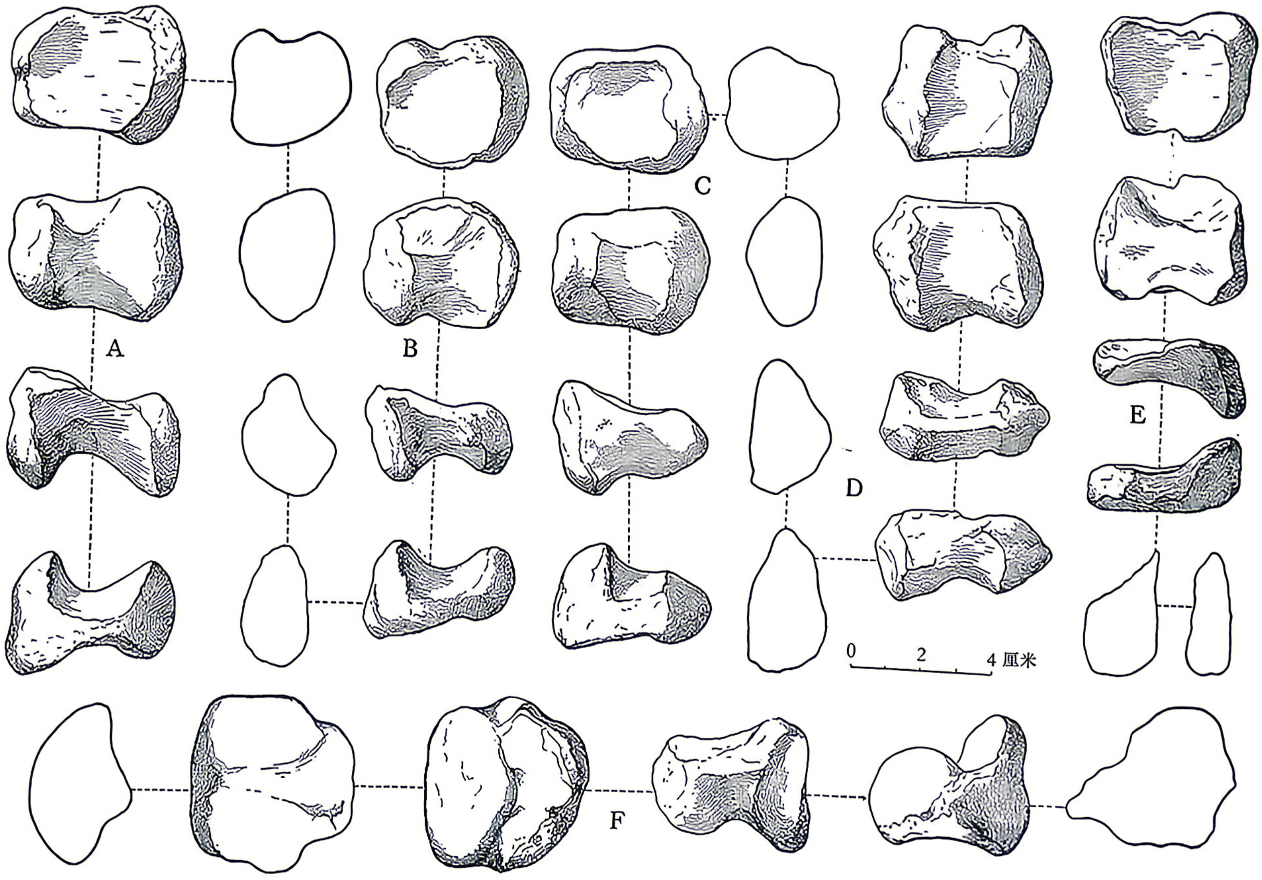


图35 山西山西鱷，新屬新种 A—E. 距骨六面观。
稜脊汾河鱷，新屬新种 F. ?跟骨六面观。詳見正文。均原大二分之一。
Fig. 35 *Shansisuchus shansisuchus* gen. et sp. nov. A—E. calcaneum in six views. *Fenhosuchus cristatus* gen. et sp. nov. F.? calcaneum in six views. All 1/2 nat. size.

**足掌骨**：所有比較保存好一些的足掌骨都見图36。另外还有几个比較破碎的，主要是两端。沒有完全的左Mt. IV，但另有一具有相当长的干部的Mt. IV 和 Mt. V在一起相連为一个体（图36，C）可供参考。如手腕骨一样，足跟骨也是比較为短而宽。Mt. I和Mtc. I相比較长一些。Mt. II–IV 和 Mtc. II–IV 相比为其干部当中不太收縮。Mt. V象其他許多假鱷类一样，末端作鈎状而上端非常之宽。

**趾骨**：在同一图上，表示了大多数所有的趾骨，包括末一趾骨（爪）。这些安排是非常初步的，因为所有这些趾骨都是零散的找見的。而这样安排主要是依據大小和形状。尽管如此，可能表示趾骨的大致情况或和实际相差不远。Mt. I的第一趾骨比較大而宽。下余几个比較細小一些。Mt. V的第一趾骨特別小而細。这一足趾，看来已退化而有成为殘余的趋向。在所有足趾上都有爪狀的末一足趾。第一末趾特別大而壮，向外依次变小。都是横的扁平而尖。有兴趣的是在每一爪的腹側近端，有一多少清楚的缺口。趾骨的数目，未能确定，极可能是2—3—4—5—3。

如果以上所描述的趾骨大致可靠的話，那末趾的总长比起所附足掌骨来說长的多。足掌骨的比較短（可能手掌骨也一样）无疑地为一較原始现象。山西山西鱷的足，令人想到一些前稜蜥、三稜龙和楔齿蜥等，特別

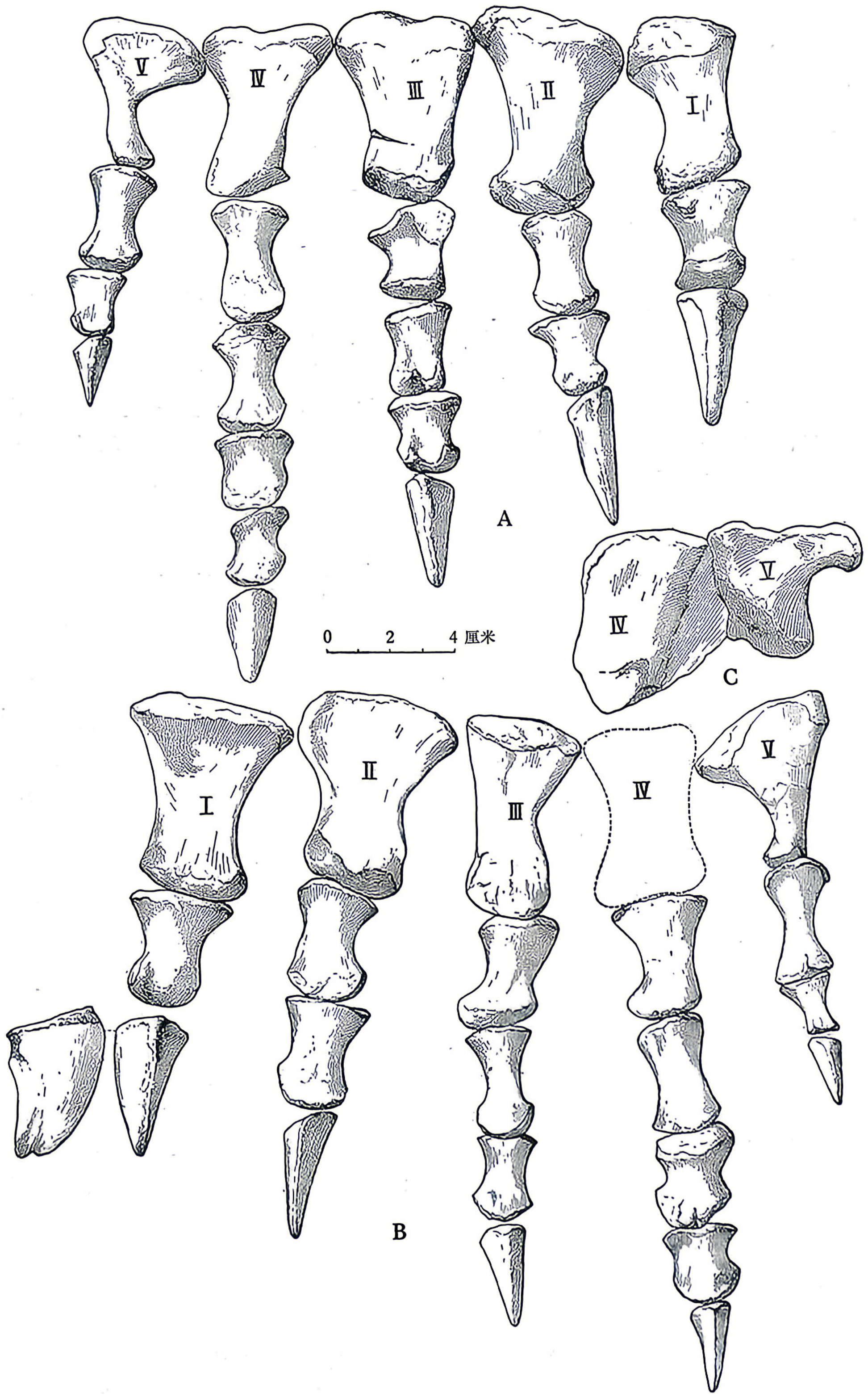


图 36　山西山西鳄，新属新种

A. 右；　B. 左足再造；　C. 左 Mt. IV—V，詳看正文。均原大二分之一。

Fig. 36 *Shansisuchus shansisuchus* gen. et sp. nov. A. right; B. left foot tentatively composed from various isolated elements of the same; C. left metatarsals IV—V in some what displaced connection. 1/2 nat. size.

是后两者，其第四趾为最长，而第五趾較宽。

总的說来，山西山西鳄的前后足，同其头后其他骨骼一样，比較原始。它的四足，一定几乎全部着地，很难适合于較快的行走。这和它的肉食性的牙齿和头骨看来是不太相称的。

关于前后足的尺度見表9（頁143）。

## 骨骼的复原和全部位的比例

象以上重复地所指出的，所有山西山西鳄的头后骨骼在堆积时十分混乱，大多数是不关連的。因此不容易成为一套一套的属于一个个体的骨架。尽管如此，为了能得到比較可靠的关于这一动物的活着的形象，我們曾試图就一些保存比較好的四肢骨和上述的一些头骨装架起来，成为綜合性的骨架。要这样做，除了武乡楼則峪西什凹（56173）地点的标本作为主要使用与补充而外，其他地点的标本，也必须使用，特别是宁武孙家沟和兴县黑峪口的标本，也予以利用，因为光56173地点的标本，不够用以装好几个骨架。为了这一目的，我們自然尽量用較好的标本，特别是繪过图的标本。不用說这样的复原只不过是建議性的，不尽可靠。譬如，許多脊椎骨的前后眞实位置，不一定完全准确，大小也不合适。又如不同成长程度的四肢放在一个骨架上等等。簡单地說来，現在所装的几个骨架，不但是綜合的，也是非常初步的，需要依新的材料加以改进。象在以下討論所申明的，这个再造可說还是非常成功的。因在这样零散的材料中能装架起来，以了解这一动物的生活面貌还是可庆幸的。

保存的脊椎骨（主要是56173地点）足够作七个比較近于完整的脊柱。但尾部几乎近于缺失。好的四肢骨可够搞三个骨架。但其他材料能做局部的壁装或石膏装的很不少。以下介紹的三个复原骨架，由本所苏有玲和李功卓两位在本人指导下作成。

第一个骨架用的正型头盖骨V.2503和其骨綜合成的头骨与下顎。所用的骨骼为：从頸到尾中部近于完全的脊椎骨，和相当完全的前肢和后肢都产自56173地点，許多已繪图的骨都装于这一骨架上，除了許多脊椎骨的背棘和神經弧以外（未加添补），相当完整。前后脚系参考图33和36的标本复制而成，这一骨架和头骨大体相称，大多数脊椎骨和四肢骨，都代表成年的个体，很少例外，这是我們唯一骨架，其所有材料均用采自56173地点的，未渗入其他地点的任何标本。

在这一装架中，几个脊椎，一部四肢骨如两肩胛骨、烏喙骨和肱骨虽近于成年，但和头骨和其他骨骼比起来还稍差一些。此外，对于一个綜合的复原来說是十分合适的。

第二个复原骨架，曾試图用56173地点的綜合头骨（V.2506），而主要用兴县黑峪口所有属于一个个体的头后骨骼来装架（V.2513）（只有单一而很破的一上顎骨未用）。缺失的部分如許多头骨前部和下顎，脊椎骨和若干四肢骨則用了56173地点的材料加以补充。遗憾的是許多由56173地点的脊椎骨都比V.2513的脊椎为小。V.2513地点的四肢骨和头骨看来較合适，其他四肢骨仅为补全之用。用上一个骨架作参考，有若干不完全的骨用石膏加以塡补或复制。前后足由上一骨架的复造而成。

第三个复原骨架也是綜合的。我們主要用宁武二馬营孙家沟的属于一骨架的所有标本（V.2501），而缺失部分用56173地点的材料加以补充。因为V.2501代表一成年或老年的个体，56173地点的脊椎骨在这一装架上，也显得太小。同样的情况是左肱骨和其他一些四肢骨。这个差别主要是由于年龄，而不是由于个体的大小的变化。这一骨架也沒有前后足，为了完全計，也从第一骨架加以复制。

其他再造，尙有待制做，不另介紹。在所有三个复原骨架缺失的尾中部和末端都沒有补齐，这动物尾巴的全貌可以在图37的复原图上看出大概，这主要是根据第一骨架繪制的。

如上指出，尽管所有制成的复原骨架比較初步，但其一般构造是彼此符合，非常一致的（可参看图版VI—IX）。我們所作的复原最与許耐为非洲引鳄所作的复原相近，且被广泛引用。

在詳細討論之前，以下的一些主要骨骼部分的比例，根据三骨架可以先叙述一下，其詳見表10（頁145）。

一共用了五个比例。第一为头和荐骨前脊椎之比，計：1为50；2为51；3为48。而非洲引鳄为57。

第二为肱骨加橈骨与股骨加脛骨之比，計：1为79；2为85；3为80。非洲引鳄同一比例为78。

第三为整前肢和整后肢之比，計：1为79；2为71；3为76。

第四为前肢与荐骨前脊椎之比，計：1为53；2为58；3为54。

第五为后肢与荐骨前脊椎之比，計：1为67；2为70；3为71。

尽管都是由綜合的骨骼所算出的比例，但以上三个骨架所得的比例給人首先的一个印象，就是所有数字相当接近。必须着重指出的就是，各个骨架复原所选择的骨骼一方面是綜合的，另一方面表示是任意抽选的。有些骨骼甚至是从距离相当远的地方采取的。但尽管如此，就所得的結果言，其差别是很小的。这一事实，可以加強这一假定，那就是这些骨骼，的确属于同一种。

另外一点值得特别指出的就是，非洲引鳄所可能取得的两个比例，和我們的非常接近。因为非洲引鳄的前后足未保存，所以后三个比例无法得到，但有理由相信，应該也很接近的。可以得到結論，两属的关系十分接近。此外所有的假鳄类种属的骨架（如果有的話）和我們现在的新种相距非常之远，不必加以考虑。

山西山西鳄的确是一个头大、身笨，而具有肉食性牙齿的动物。这个动物不善于快跑，也沒有什么防御的东西。但尽管如此，在三迭紀犬颚兽时代是一个很成功的发育的动物，而且分布很广。可能当时沒有另外的动物可和这样大而肉食性的动物相竞爭。而另外其他同时的一些大大小小的犬颚兽类和其他四脚类动物也大多数同样的笨拙，容易被捕捉，因而象山西山西鳄那样自相矛盾的构造，并未构造成特殊的缺点，还可成功地活下去。但尽管如此，逐漸兴起的肉食性的犬颚兽，无疑地不断威胁着这一类动物的生存，而到最后，逃避不了完全灭亡的命运。

## 比較与討論

在以上叙述中显得非常清楚，那就是唯一可和我們研究的种相比的属，为南非的引鳄，和新近发表的苏联的武氏鳄和加氏鳄。最后一属只見一个初步报导。另外按着塔塔林諾夫在一篇評論中所发表的意見（Tatarenov, 1961）和新发表加斯馬吐鳄（*Chasmatosuchus*）；*Vjushkovia* Orchev 再加上早已知的通古斯鳄（*Dongosia colorata* Huene）都当归并为一属，归于引鳄属。但在得到眞正比較可靠的分类以前，在以下比較中，还是分开来看待。另外，两属加斯馬吐鳄只有一左前上颚骨；通古鳄，只有一背脊椎。因为材料太破，未在下表中作对比。关于加氏鳄除几个脊椎骨外，沒有看到任何头后骨骼，而我們的观察只是根据縮尺很小的图，可以对其对比的价值要大大加以保留。

在表11中（頁147），一共列举了三十四个不同的性质分别就山西山西鳄、引鳄、武氏鳄和加氏鳄加以对比，詳可参閱該表不再重复。但有以下几点，可以着重地指出：

1. 在头后高和头长的比例上山西鳄和引鳄最接近，前者为47，后者为46，而和其他两者較远。
2. 头骨的宽长比較和武氏鳄較近，为一显然特长的头。
3. 眼前孔共有两个，与所有属均不相同。
4. 上颞颥孔三角状，前綠与头骨轴垂直，和外側所成之角微作鈍角。在引鳄前綠与头骨轴斜交，与外綠成銳角。武氏鳄前綠和头骨轴成斜交，与外綠成一特大鈍角。
5. 无顶骨孔。引鳄有顶骨孔。武氏鳄无。
6. 間顶骨后端有一突起。引鳄有，武氏鳄无。
7. 眼眶前綠位于额骨鼻骨縫合綫較后一些。引鳄很近，武氏鳄特远（？）。
8. 额骨不参加眼眶边綠。引鳄参加一部。武氏鳄参加一大部分。加氏鳄与引鳄情况同。
9. 额骨和鼻骨以犬牙交錯状相接。引鳄同。其他不詳。
10. 鼻骨长逐漸向前变窄，中部无清楚的收縮。引鳄則向前急剧变窄，有較显著的中部收縮。武氏鳄向前变窄，有中部收縮。
11. 枕骨大孔作横的加宽，引鳄較圓，武氏鳄横向加宽。
12. 两顶骨后突起約成直角，引鳄相同，武氏鳄为較明显鈍角。
13. 上颚骨的上突起距前端有一距离，用以分开两眼前孔，外面平，内面凸出。引鳄无，武氏鳄也无，加氏鳄无。
14. 下颚接合处加厚加大。引鳄不詳，武氏鳄未加厚加大。加氏鳄稍微加厚（？）。
15. 前上颚骨牙6；引鳄5；武氏鳄（？）；加氏鳄5（？）。
16. 上颚骨牙12±；引鳄9（？）；武氏鳄未詳，加氏鳄14或15。

17.下颚牙 12（？）;引鳄 11; 武氏鳄 8＋（？）;加氏鳄 13 或 14。

18.颈脊椎。可能为 9 或 10。边緣反轉加厚，而微凹，无間椎体，前部脊椎高超于宽，后部者約相等。引鳄相同，但有間椎体。高超过于宽。武氏鳄 7(？)，椎体較长，无間椎体;加氏鳄长与高約相等。无間椎体。

19.背脊椎。可能为 15。比較短，前部者有时腹側有稜。引鳄相同，前部者边緣也加厚。武氏鳄腹側无稜。

20.荐骨脊椎 2，引鳄 2，武氏鳄 2。

21.尾脊椎 35＋（？），引鳄 35，武氏鳄(？)。

22.肩胛骨中部特收縮，近端窄于远端。引鳄的相同。武氏鳄近端宽于远端。

23.烏喙骨。前緣加厚，烏喙孔未穿透，較伸长，比較小，作三角狀。引鳄大致相同，武氏鳄者烏喙骨孔距边緣远，且穿透。

24.間鎖骨。存在，很薄，近端后稍收縮。引鳄未詳，武氏鳄近端大，甚为收縮。

25.肱骨。两端微作扭折，三角稜向下伸至中点以上，关节部不大显著。引鳄两端扭折較大，几成直角。三角稜引鳄到近中点处。武氏鳄的与山西鳄同。

26.尺骨。肘突发育不全，比肱骨稍短。引鳄同。武氏鳄同。

27.橈骨。近端窄，远端特宽，比尺骨稍短。引鳄短而宽，两端扩展。武氏鳄同山西鳄。

28.腸骨。前端突起几乎等于无，非常鈍。引鳄稍发育。武氏鳄較鈍。

29.恥骨。比坐骨稍短，恥骨孔靠边緣。引鳄相同，但恥骨孔封閉。武氏鳄比坐骨特短。

30.坐骨。坐骨板弯曲，后內側缺口深。引鳄同武氏鳄几无缺口。

31.股骨較直，两端不太扭折，也不太加宽。关节处比較骨化。大关节处骨化不全。武氏鳄同。

32.脛骨。近端較窄，比股骨为短。引鳄同(？)。武氏鳄同，比脛骨只稍短。

33.腓骨。瘦細，較直。引鳄未詳(？)，武氏鳄相同(？)。

34.跟骨。平板状。引鳄相同，其他未詳。

由上述一些性質来看，就广义来說，彼此似乎很相近，形成一自然羣，和較原始的原鳄科(如加斯馬吐龙)旣不相同，也和后期其他的假鳄类很不一样。在所有四个屬，头骨都較伸长，上顬顬孔口向上开，眼眶特别大，下顬顬孔也很大，方骨比較不向后傾斜，而近于直竪。肉食性的牙齿和下顎骨有一大的下顎孔(引鳄为例外)。此外所有这些屬(除加氏鳄以外)的頸脊椎較短或者很短。背脊椎一般无稜或不太发育。两个荐骨脊椎，四肢骨一般比較原始。所以这一类动物，介于原鳄和其他特殊化的假鳄之中間状态，似乎是沒有什么疑問的。

但在另外一方面，在中国所发見的这一假鳄，同其他所有已知的屬相比有非常显著的差别。那就是具有两个眼前孔。甚至沒有一个其他已知的槽齿类，具有这样的特性。但是当我使用許耐和步林克的著作时有一很深的印象，那就是非洲引鳄，很可能也具有两个眼前孔。其第一个理由是許耐所用标本的左上顎骨（可能为右，原图內外似顚倒）(許耐，1911，图版 IV，图 1，)的上伸突起位置相当靠后，且有一圓状輪廓，差不多和我們的标本一样。另外它的右前上顎骨也有应当位于鼻孔后的一个突起。这个突起相当靠上，不可能是下緣向后伸处。把这些事实合在一起，好象表示眞有一第二眼前孔介于鼻孔和第一眼前孔之間。这个第二眼前孔后边为上顎骨的上突起，而前边为前上顎骨的向后突起和我們的种完全一样。照許耐所作的复原看来，一部分眼前孔显得太小，也不自然，很可能有錯誤。第二个理由是，根据步林克（1955，p. 140，Fig. 2）所作关于同一种的新发見的头盖骨的观察，这个头骨前部保存完好，似乎表示有两眼前孔的存在。照步林克的图，左侧鼻骨，在前边一輕微缺口和后边較显著的缺口之間，有一很深的沟，紧位于靠鼻骨收縮部分之前。这个情况很可以和我們山西山西鳄相比較(参看图 1，2，3，4 及 7)，前一个微弱的缺口，代表鼻孔的上后角边，而后一个缺口(大一些，深一些)代表第一个眼前孔的上后部。至于这深的沟乃是为前上顎骨后突起插入之用。如果上述的解释可靠的話，很可能沒有什么怀疑，非洲引鳄也具有两个眼前孔。

至于武氏鳄究竟如何，就不太清楚。左前上顎骨的后部(許耐，1960，Tab. 11，Fig. 7）有损伤，但有一向后突起存在的可能性，不能完全排除。按照奥尔奇夫的图，加氏鳄只有一个形状很特别的眼前孔。

把以上所述各点加以考虑以后，我們可以进一步来考虑这几个屬和我們的种的比較。

同非洲引鳄来比，以下各点，在山西山西鳄也具有或者比較近似，那就是 1，6，9，10，12，15，16，17，18，19，20，22，23，25，26，27，29，30，32 和 34。那就是說，几乎三分之二的性質相当接近或差不多一样。特别要指出的，为山西山西鳄的距骨虽然較厚而壮大一些，但一般形状基本上可以和引鳄的距骨相比較

的。因此，我們必須承認，非洲引鳄是我們到目下为止，最接近于我們的种的一假鳄类。但在另外一方面，以下的性质表示两者之間有很大的差別，为 2，4，5，7，8，11，?13，28，29。其他未列举的性质是比較两可的。在这些差异中，最值得令人注意的是：头骨的狹窄，上顳顬孔的特殊形状，顶骨上顶骨尖的消失，额骨的形状和位置，及下顎骨下顎孔的缺如等等。

引鳄到底有沒有第二个眼前孔（虽然极可能有）尚可存疑。鉴于我們的种所具有的那許多特性，建議把山西山西鳄代表一新科，卽山西鳄科，其特性在前已經指明。山西鳄科和同一超科的原鳄科大不相同，是十分清楚的。后一科的牙齿为端生齿，前上顎骨向下弯曲，方骨非常向后傾斜，上顳顬孔較向側面一些。更重要的是只有一个眼前孔等。同其他两科一样，我們这一科也暫归于原鳄超科（Proterosuchoidea Camp = Proterosuchia Broom, Pelycosimioidea Huene）。

当作目前研究的一个結論，我們不能同意这样一个意見，那就是認为非洲引鳄，連带着和它相近的种类为一特殊化的最終种类。这些动物以四足行走的一事实本身，就說明并不特殊化，特别是同后期多数用后脚行走的恐龙相比。关于头骨，一般地說来更不能認为有什么特殊化，如 Aetosauridae 科[照瓦尔克尔（1961）分类的概念]的头骨那样或者照其他后期一些小的假鳄类，其头骨各部分的安排很不相同。在另外一方面，我們觉得极有可能，山西山西鳄代表肉食性的蜥龙类（一般地归于虛骨龙或肉食龙类）的較原始的一級。晚三迭世的 *Teratosaurus* 似乎可能就是山西鳄的后代殘余。因为不但其头骨可以和山西的标本相比較，其足骨也有些相象。晚三迭世恐龙这一属的前肢当然大为变短（参看許耐 1932, p. 322，关于 *Teratosaurus minor* 的四肢骨比例），而我們标本的相当的部分却非常之长，換言之卽为四足行走者。不过我們不要忘記，山西山西鳄的前肢（肱骨加橈骨）和后肢（股骨加脛骨）的比例所示，其前肢已开始变短（見表 10）。似乎可以相信，从早三迭世的上部到眞正的晚三迭世中間可以有足够的时間，让前肢短些又短些。甚至侏罗紀和白堊紀的一些肉食类性虛骨龙和肉食龙如 *Compsognathus*, *Ceratosaurus*, *Megalosaurus*, *Antrodemus* 以及 *Velociraptor* 等的头骨也或多或少和山西山西鳄的头骨构造有些可以比較之处。所有这些属，上顳顬孔均向上开口，鼻孔離前端很近，且具有一較小的眼前孔和一特大的離后的另一眼前孔，或多或少直竪的方骨，和一个大的下顎孔。

最近的研究表示，蜥龙类的各类来源是不同的。看来越来越清楚，肉食类恐龙的来源要在原始的槽齿类中去找，而我們的山西山西鳄看来是很合适的一个候补者，至少是很有关系的一个。

**同武氏鳄相比**：这一属也有若干性质和山西山西鳄相同（5，?10，11，20，24，25，27，28 和 33），但却有更多的性质不很相同（1，3，6，12，13，14，18，19，22，23，26，29，30，31）。其他性质是可以置疑的。武氏鳄比山西山西鳄至少小一倍，当然比非洲引鳄更小。它的地质年代，依許耐等所指出，比較晚一些。所以我想武氏鳄必然代表另一独立的属。

塔塔林諾夫把这一属归于引鳄一属，但卽就是丢开眼前孔的多少不談，以上所指出的性质和原因，这意見定不能接受的。当然武氏鳄还是一个原鳄超科的成員，所以具有一些共同性质是毫不为奇的。

在我們的材料中，也另有一較小的种将在以下加以叙述。

**和加氏鳄的比較**：象以上所指出的，关于加氏鳄我們可辦的不太多。但仅就奥氏所給的图来判断，它的特別形状而又单一的眼前孔，前顎骨稍微下垂的情况，和方骨較向后斜的位置等等，很难相信它和我們的种之間有何亲密的关系。塔塔林諾夫也把此属当作和引鳄的同物异名，而他的假設的依据本身很有問題，因为他首先确定武氏鳄不能成立，而他所对比的一些性质都是以武氏鳄为根据的。从地层上和解剖上的观点来看，我們完全不能同意这个說法。按照叶菲里莫夫的地层对比，加氏鳄产自下三迭統下部，而武氏鳄则自中三迭統下部。上已提过，加氏鳄代表一短头型的种（也归原鳄科）而与引鳄相差很远。

总的結論是：山西山西鳄应代表一新的科，归于原鳄超科。可以假定它和以后肉食性恐龙包括虛骨龙类和肉食恐龙的祖先有密切的关系。

### 黑峪口山西鳄（*Shansisuchus heiyuekouensis* sp. nov.）新种

## 一 般 引 言

在研究山西山西鳄过程中，认識到在同一地点56173至少还有三种不同的动物。在少数其他地点，也有同样情况。其中有一种似乎同上述的种很为相近，今在此加以叙述。这是一个在大小上比上述种較小，而构造上也有一些与前者区别的种。

因为56173地点和其他地点的材料，大多数都是破碎的，而彼此連系不清楚，所以在相当时間，我們对于建立另一种确实有些犹豫。这个問題由于1960年从山西兴县黑峪口(60116)找到属于同一个体的大部分相連的背脊椎和一部分荐骨和尾脊椎以及一些保存很好的四肢骨而得到解决。这一批化石即当作这一种的正型，而其他的均为副型。虽然从那些副型标本上所观察到的性质是否能作为这一种的特性，可以有些怀疑，但在很大程度上，应当視为是接近真实情况相当可靠。这主要由于归其他要描述的属，更不可能。如下述的稜脊汾河鳄大小和山西山西鳄差不多，脊椎构造很特别，且具有甲板，而王氏鳄则躯体更小，也具有甲板，所以归于这一种的标本，不大可能和其他种混同起来。应当認为所列的材料是比較可靠的。

## 描 述

**正型：** 十七个大致連續的脊椎骨，肱骨上下端碎片，完整的左股骨和近端缺失的右股骨，两脛骨的近端部分。野外号碼60116，登記号V. 2513。

归入这一种的标本，計：

(1) 武乡楼則峪西什四(56173)，一左上颚骨；二方骨（另外有些头骨和下颚骨的碎片也可保留地归入此种）(V. 2514)；45个零散的脊椎骨；6个零散的荐骨脊椎；两左三右肩胛骨（另有一些碎片）；一左五右烏喙骨；二左一右将近完整的肱骨和一些肱骨的两端；两左五右橈骨的近端和一些碎片；一近于完全的左尺骨；二腸骨和一些碎片；一左恥骨；一左坐骨；一扭曲的左股骨和一些不完全的股骨；二脛骨近端和一些腓骨或可归此种。以上列举的标本說明从这一地点大約有五个或較多的个体。

(2) 武乡石壁西北盘頂(5523)若干零散的脊椎骨(有坐骨脊椎1)，肱骨末端，右股骨两端和一些碎骨(V. 2516)。

(3) 武乡东河村大南洼(5526)。一左肩胛骨的近端(V.2498A)。

(4) 武乡楼則峪石片沟(5537)。破的荐骨，肋骨，肩胛骨和？尺骨可能归此属(V. 2517)。

(5) 榆社銀郊小土沟(5675)。

(6) 武乡楼則峪狼窝沟(56156)。两个股骨的远端和一脛骨的近端(V. 2496)。

(7) 武乡楼則峪十个洞(56159)。九个破碎的脊椎骨，肱骨两端(V. 2494A)。

(8) 武乡二郎山(确实地点不詳)。一尾前部脊椎 V. 2695。

(9) 宁武大場虎台沟(NWG, ED,)。六个荐骨和尾脊椎和一荐骨肋骨(V. 2696)。

**层位与地点：** 下三迭統上部，山西兴县黑峪口(60116)和如上所列的一些其他地点。

**特征：** 比山西山西鳄小四分之一到一半左右，頸脊椎比較长，和加斯馬吐龙相似。前部背脊椎較短，愈向后愈延长一些。少数脊椎似有第三肋骨关节存在。前部背脊椎的側面稍凹入而腹側具有浅而宽的沟。較后背脊椎的腹側則成为較弱的直稜。肩胛骨的近端和远端大致相等。肱骨的前上端作勺状，有如 *Halticosaurus*。腰带构造可能和山西山西鳄相近似，但有大的恥骨孔且离坐骨边很远。股骨較弯曲，不如前一种之直。

### 关于正型标本的描述

**脊椎骨：** 十七个来自60116的脊椎骨，示于图38A。此乃依照大小形状而排列，很可能即代表原来的順序。图上所示的数字，乃代表我們所認为的前荐骨脊椎，荐骨脊椎和尾脊椎的号次。19—20，21—22和24—25还彼此連接。依照这样的安排，背脊椎14—16，付之缺如。头两个背脊椎代表頸脊椎的最后两个，其构造和形状，很象以后头三个背脊椎。它們比較短一些，椎心中部只稍微收縮。但其側面，有很显著的凹入。脊

椎的腹侧具有浅而较平的沟。侧突的位置很低。从第十七脊椎起,椎体显著变长而两侧的凹入,几乎完全消失。腹侧有一很弱的直稜。假定的两荐骨脊椎,保存不全。肋骨的一部分,尚附着于脊椎之侧。最后两脊椎当作是尾前部的脊椎。横突位置較高。第二脊椎表示出腹棘的接触面很清楚。所有脊椎都是属于成年个体的,但其大小比上述的一种的相当脊椎小的多。

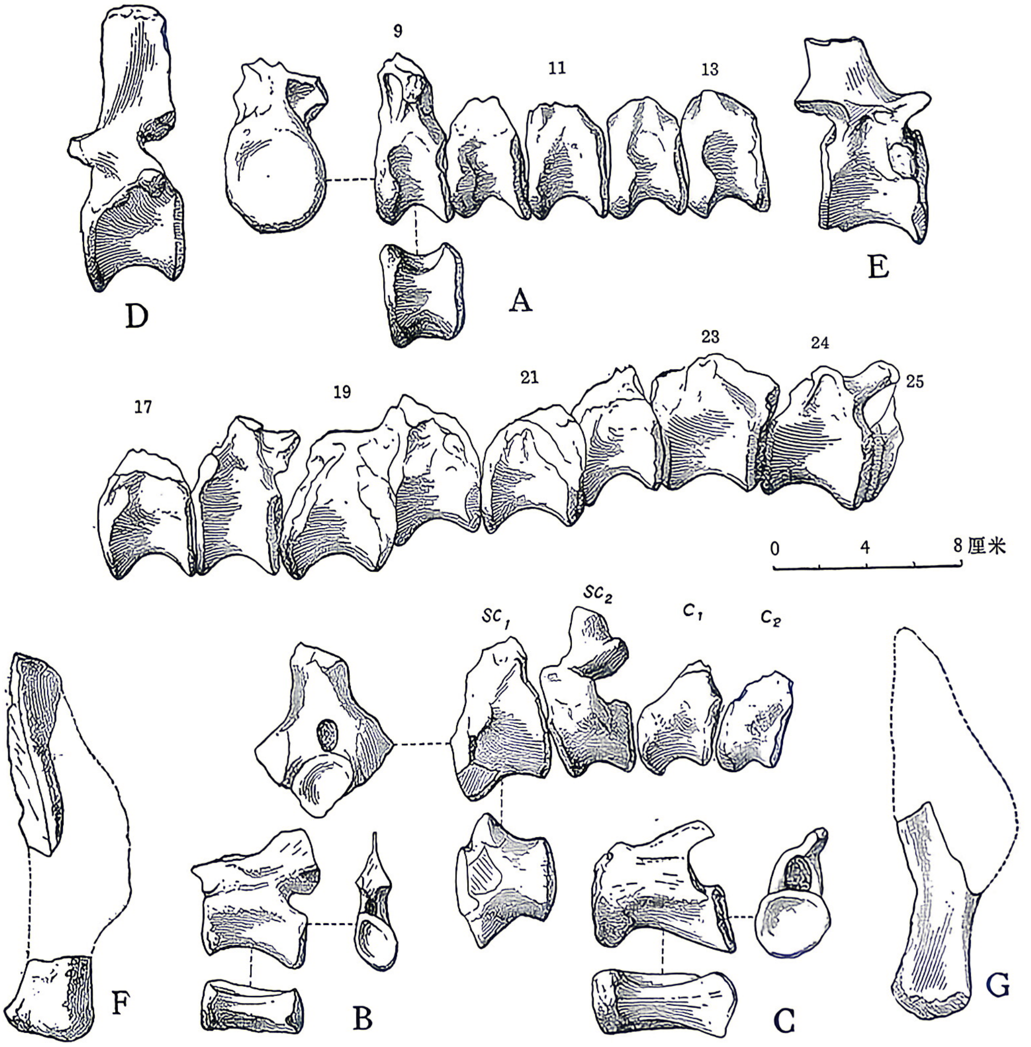


图 38　黑峪口山西鰐,新种

A.60116 地点脊椎骨; B—C. 二颈脊椎; D—E. 5523 地点两背脊椎; F—G. 二方骨。詳见正文。均原大三分之一。

Fig. 38 *Shansisuchus heiyuekouensis* sp. nov. A. a series of dorsal, sacral and anterior caudal vertebrae from Heiyuekou Shinghsien (60116), N. W. Shansi of the same individual. The numbers indicate showing the probably position of the vertebrae in the column. Right side view with a few showing the anterior or posterior or ventral aspects; B and C. two neck vertebrae belong probably to this species. in lateral posterior and ventral views showing the well developed parapophysis facet and the amphycoelous end; D and E. two posterior dorsal vertebrae from locality 5523 in lateral views; F and G. left and right quadrates in anterior (F) and posterior (G) views. All 1/3 nat. size.

所保存的两肱骨碎片(图 42, A—B) 的大小, 約介于其他归于此一种标本的成年的和幼年的个体之間。其近端一个(图 42, A) 可能为左侧,只近关节处的后面保存一部分。 远端的 (图 42,B) 一块可能也是左边的,大小和上述标本相称,所以有可能属于同一个体。尺骨和橈骨关节很清楚。由末端起向上突然变窄, 特别是內侧的一边,表示骨干的中部,必然相当显著地收縮。

**股骨**(图 42, C、D): 左边完全保存,大致构造和山西山西鰐很象。但从外侧看,有较显著的弯曲,第四

轉节极不明显，脛骨与腓骨的关节发育很好，左側的股骨和右边者完全相同。

**脛骨**(图42，G、H)： 也較弯曲，如图所示可以看出。

股骨和脛骨，都比較瘦小一些。

### 副型标本的描述

以下为关于列入这一种的其他标本的簡单記述：

首先是在图10C所示的一左上顎骨同其他上顎骨比来非常之小，但却为一成年个体，所以很不可能归于山西山西鱷一种。同样理由，也不可能属于在以下要討論的汾河鱷。很可能这一上顎骨归于黑峪口山西鱷。从构造上講，这个上顎骨和山西山西鱷的上鱷骨很相象。向上的突起位置也比較靠后，牙列的构造以及上顎內凸外平情况，完全相同。 这些性质說明至少头骨前部的构造应和上一种差不多，极可能也有两眼前孔(V. 2514A)。

**方骨**(图38，F、G)(V. 2514B)： 这两块方骨，由于較小，可能归黑峪口山西鱷这一种，但沒有特别可以值得指出的特性。

必須指出，在以上所描述的山西山西鱷中，有些头部和下顎部分的归属，特别是較小的标本，并不是毫无疑問的。如图9C的前顎骨和图14A的鳞骨等。

所有这些事实表示，或者这些可疑的标本，都归于山西山西鱷，而大小的不同，只不过是或者为个体的差异，或者为年龄的区别。另外一种解释，就是两种头骨构造相当近似，但确为不同的种。 因为脊椎骨和四肢

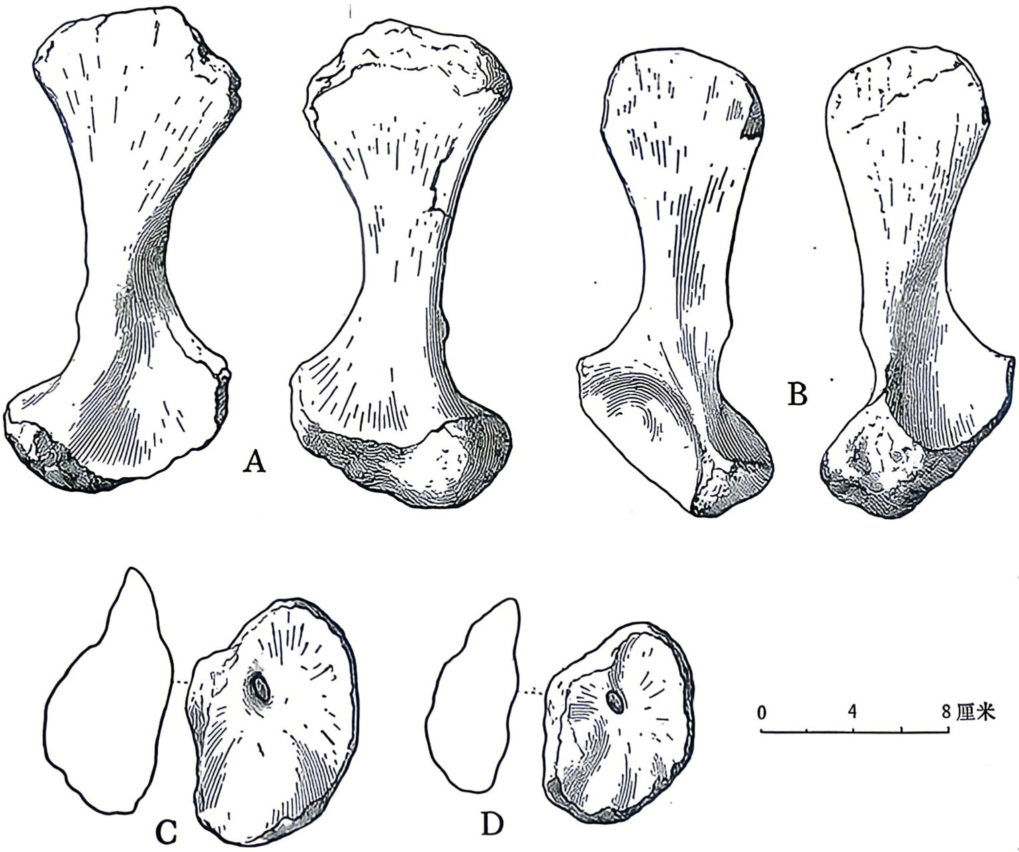


图39 黑峪口山西鱷，新种

A. 左； B. 右肩胛骨；C—D. 二右烏喙骨双面观。詳看正文。均原大三分之一。

Fig. 39 *Shansisuchus heiyuekouensis* sp. nov. A. left; B. right scapula in two views; C and D. two right coracoids in external views with the outline of the glenoid surface. Note the difference in size and thickness. 1/3 nat. size.

骨的构造差别相当显著,我們相信后一个可能性比較大一些。

图 38 B 和 C 所示的两个脊椎骨,值得特别指出。这两个脊椎后端很深地凹入(其前端較平,或者較浅地凹入),椎体突很低(在小的一个——B,椎体突較不显著,但清楚地存在),在椎体的腹側和側面均有显著的直稜起自椎体前端,而向后变弱,所有这些性质只能說明,这两个脊椎骨代表頸部脊椎。可惜两脊椎的上部都保存不佳,不能作更多的例証。两脊椎的大小,可以和这一种的相比較为合适。比前一种和下边要叙述的汾河鳄都小的多,而比王氏鳄则較大,除非除了大头龙和以上所提到的假鳄类以外,还有一新加种,以若干脊

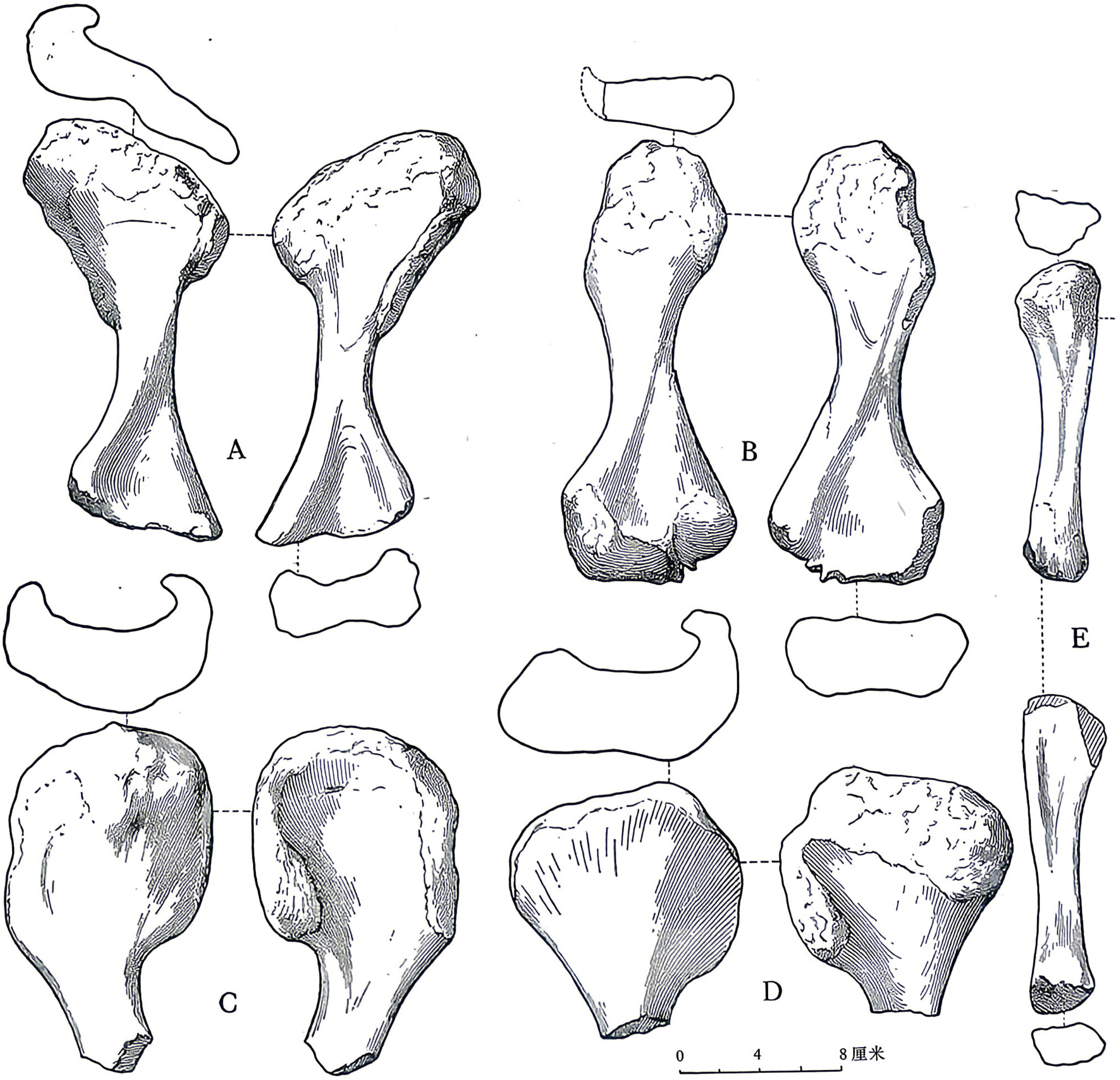


图 40　黑峪口山西鳄,新种

A. 左; B. 右; C. 右; D. 右肱骨双面观; E. 右尺骨,双面观。附保存的两端輪廓。均原大三分之一。

Fig. 40 *Shansisuchus heiyuekouensis* sp. nov. A. left (in the plane of distal end); B. right; C. right and D. right humeru in two views, and with the outline of proximal and distal ends; E. ulna (right) in two views and outline of both ends. 1/3 nat. size.

椎骨和肩胛骨为代表,这两个脊椎骨之应归于这一种看来是可以肯定的。因为上一可能性是不大的。若果如此,由于颈脊椎的伸长这一性质,使得这个新种具有一非常特殊的特性。这頸脊椎比背脊椎較长的性质見于老的加斯馬吐龙,和后期晚三迭世的蜥龙类各属。

其他由56173地点所采的背脊椎等,比起正型标本来,稍大一些。有时同山西山西鰐的区分是可怀疑的,有困难的。但是平均起来看却小一些,清楚地接近于这一小的种,而不大可能归于大的山西山西鰐。另外产自5523地点的两个背脊椎(图38, D—E),比正型的相当脊椎稍大一些,这两脊椎的上部保存。背棘窄而长,末端沒有加厚现象,說明这一种大概沒有甲板发育。横突很短小。其中一个微向上伸(D属于背前部),而另一个稍向下垂(E属于背后部)。比較有兴趣的是在横突下綠横突和椎体之間有一加厚部分,表示肋骨有第三关节的存在,一如許耐所描述的武氏鰐那样。在大量的山西山西鰐脊椎骨中和其他属的脊椎骨中,都沒有发見这个現象。所以十分可能这两个脊椎骨和同一地点的一些小骨骼(脊椎骨,四肢骨等)属于这一种。

在这里列入这一种的肩胛骨(图39, A和B),比山西山西鰐一般地小一些。它的远端比近端为窄,或至少略相等。烏喙骨(图39, C和D),其区别除了較小以外,沒有那么淸楚。同山西山西鰐一样,肩臼面相当的厚。烏喙骨孔接近边綠。

列入这一种的肱骨(图40, A—D)有以下的性质較为显著。1,小一些;2,两端扭曲較显著;3,三角稜較不向下伸(但在图40, A为一例外,其三角稜較向下伸。但这一部分十分凹入,似乎受了挤压,而有些变形)。此外,肱骨近端前部作显著的勺状。它的近端旣不照山西山西鰐那样,作断切状,也不照汾河鰐那样,驟然向下弯。它的骨身比較为短。肱骨远端不太加宽,两关节的分隔也不显著。总的說来,这一种的肱骨和 *Halticosaurus* 的十分相象 (Gregory, 1951. Vol. II, pl. 525, p. 530),而和引鰐的肱骨大不相同。就一般形状諦,它和 *Stagonosuchus* 为近,而与武氏鰐較远。

关于下前肢,两右尺骨(一自56173,一自5537)保存較好(图40,E),它比肱骨短的多,但相当瘦小。和山西山西鰐比,除了小一些以外,区别不大。有一些破碎的尺骨和橈骨,可归此种,但看不出有何特别的性质。

关于腸骨(图41, A和B),很难从上述一种,找出什么显著的区别。除了較小以外,髋臼的恥骨边和坐骨边可能形成一較淸楚的鈍角。腸骨板向前突起,也較为发育一些。总的說来,同山西山西鰐很象。

恥骨的一般构造,几乎和山西山西鰐相同。但有一显著的区别,卽有一大而椭圓的恥骨孔,且距坐骨边綠相当之远。因此很淸楚和这一种不同。另外下述的汾河鰐的恥骨具有长柄,与此大不相同,所以这个恥骨归于这一种的可能性特别大(图41, C)。

**坐骨**(图41, D): 列入这一种的坐骨,也很特殊。其一般形状虽然可和山西山西鰐相比,但是特别厚而短。在近端和腸骨接触面与髋臼本身的面,区别不太淸楚。

另外有两个可疑的标本,也打算在此附带提一下。

一个是左腸骨(图41, E),其下部髋臼处稍有損伤。此骨的前外部分的非常特别的加厚,应当解释为一种病态发育。这个說法由以下事实所支持,那就是其內側沒有荐骨肋骨的印痕,而整个骨面較为凹入。

另外一个标本是右恥骨(图41, F),虽然很小,但一般形状和上述的差不多。所不同的是恥骨孔只有在腹側有一点沟状殘余,而在內側完全看不見。它的前內側边綠,也大为簡化,所以只形成了一个銳尖状的远端,而不是一个眞正的加宽的边綠。

这两个标本的归属很不淸楚。恥骨的特别形状,可能表明,在这一槽齿类动物羣中,还有其他未知的种存在。那腸骨也很特別。关于这个問题,以下另有机会,再为討論。

**股骨**(图42, E, 自56173): 所示的一个股骨,显然是一个病态的骨骼。这骨属于左边,其两端大有变形,股骨近端下的粗糙面,和骨的干部完全愈合,表示該动物在生时受伤而又复原。远端已表示相似情况,以至于两关节的分开,变成不很淸楚. 从側面看,股骨作"S"状的弯曲,正和正型标本一样。

另外从5523地点(V. 2516)的股骨上端和下端(都是右边),也表示受了伤而又复原的现象(图42A)。两骨极可能为一个体。上端的下部破裂处,淸楚地加厚,破面的骨心封閉而光滑。下端的上部破裂地方稍有損

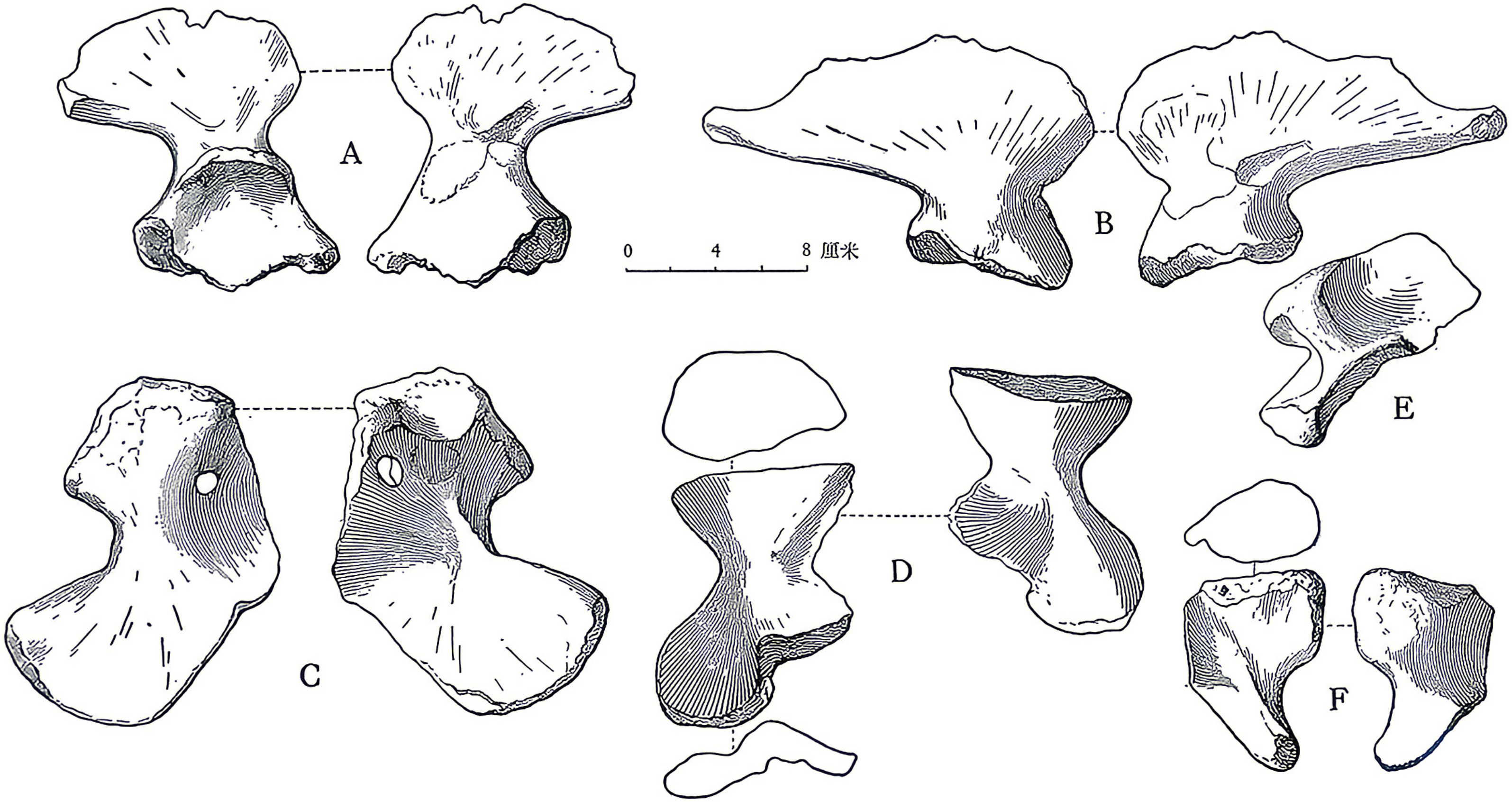


图 41　黑峪口山西鳄，新种

A, B. 右腸骨； C. 恥骨； D. 坐骨，均双面观，不能鉴定的骨骼； E. 左腸骨； F. 右恥骨。詳看正文。原大三分之一。

Fig. 41 *Shansisuchus heiyuekouensis.* sp. nov. A. and B. right ilia in external and inner views; C. pubis in two views. This specimen is almost too large for this species. The enclosed pubic foramen excludes the possibility of being that of the form illustrated before; D. ischium in two views with outline of both ends. Os. indet; E. left ilium; F. right pubis. For details see text. E. in external view; F. in two views with the outline of the proximal end. All 1/3 nat. size.

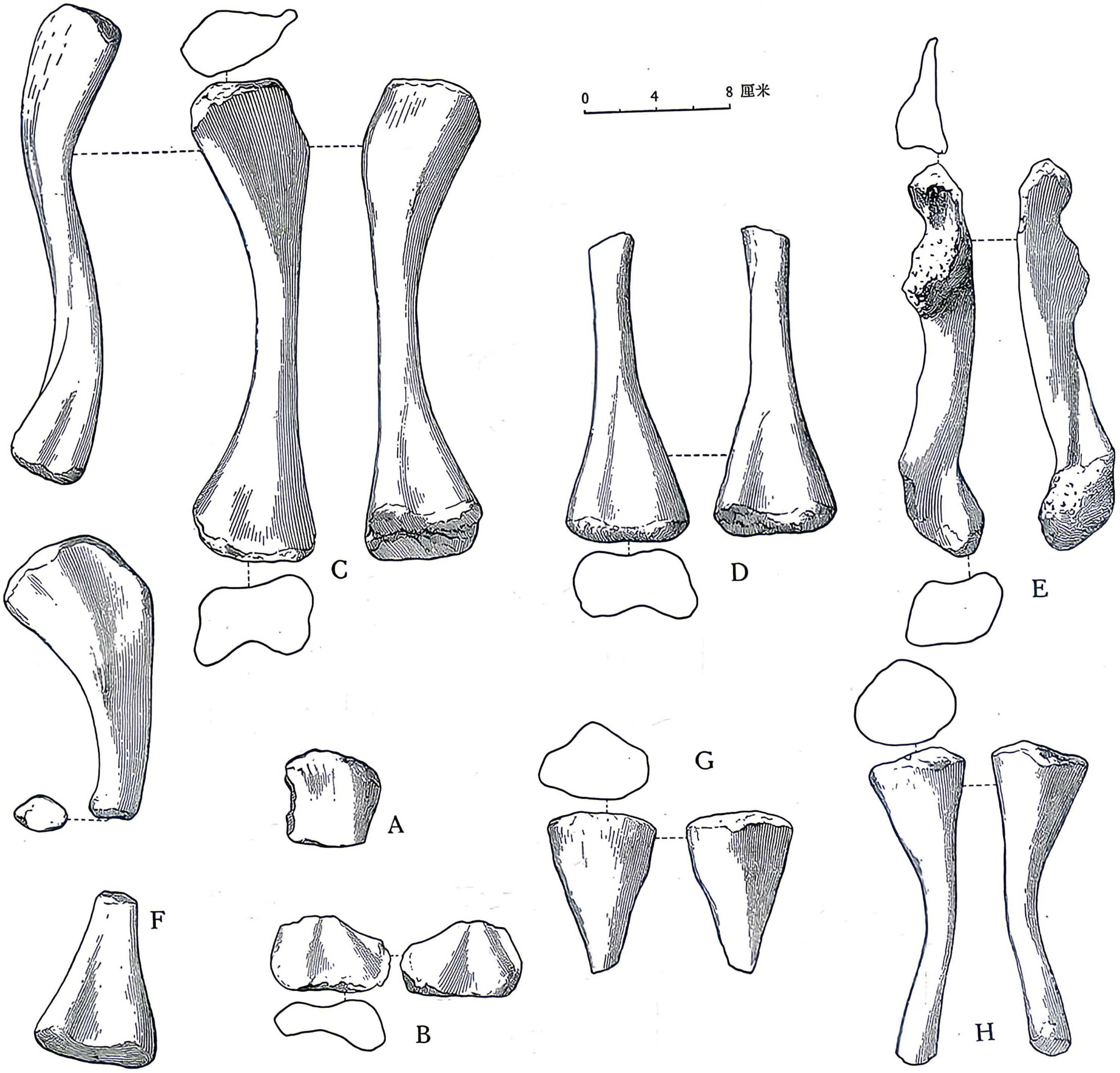


图 42　黑 峪 口 山 西 鳄，新 种

A, B. 肱骨； C—F. 股骨； G—H. 胫骨。詳見正文。均原大三分之一。

Fig. 42 *Shansisuchus heiyuekouensis*. sp. nov. A. fragment of proximal part of a humerus; B. distal end of a humerus from Heiyuekou belong probably to the same species and individual as the vertebrae; C. left femur inner, anterior and posterior views with outline of both ends from Heiyuekou (60116, V. 2513) same individual as before; D. distal part of the right femur from 60116, same individual; E. a distorted and pachyosteous left femur in two views; F. a left femur broken at the middle by injury during life and recovered latter before death from the locality, 5523; G and H. left and right tibia from Heiyuekou (60116, V. 2513) in two views and outline of the proximal end. 1/3 nat. size.

坏,不大清楚,极可能同上端差不多。两骨的构造和正型标本相同,只是稍大一些。

此外有一些較小的跟骨,一般形状同山西山西鳄相同,可能归于此种。其构造和上一种相同,不再重述。

关于黑峪口山西鳄的尺度大小,見表12(頁154)。

## 鉴定与討論

不幸的是正型标本保存的不够完全。特别是头骨部分,肩带和腰带部分,全付缺如。就所保存的部分来推断,骨骼可能完全地包于岩层之中,可惜未能采出。尽管如此,已有的脊椎骨、四肢骨足够表示,我們面临一新的假鳄类。正型标本的脊椎骨比山西山西鳄相当的脊椎至少小一半,而正型的股骨和脛骨,比起同一种来也至少小四分之一。虽然如此,60116的标本,由其脊椎的性质和四肢骨的分化很好关节来看,确为一成年个体。荐骨脊椎和荐骨肋骨間的愈合,也支持这个看法。尽管脊椎骨的一般性质和上述种有些相似,但这一种脊椎的椎体肯定比較长一些。股骨也特别作“S”状弯曲。所以看起来黑峪口的标本,比起更大的山西山西鳄来应为一不同的种是十分清楚的。

但是究竟这一新种是当作和山西鳄同一属的新种呢,还是另外代表一新的属?很难作肯定的回答。

事实傾向于把黑峪口的当作和山西鳄同一属的为:第一,黑峪口的脊椎骨和四肢骨,虽有若干区别,但一般性质还是比較近似。第二,在归于这一种的副型标本中,有些性质和山西山西鳄很近,如肩胛骨、烏喙骨、腸骨、距骨等。第三,在有些情况下大小的区别,和山西山西鳄来比,不是突出地显著(当然还是小的多),如一些較大的脊椎骨,大的肱骨和大的腰带骨等。这些事实結合在一起,好象表示,应当把黑峪口标本当作归于山西鳄一属的一新种,而不必另立一新属。

另外一方面,事实傾向于設另一新属的为:第一,頸脊椎很长,背脊椎也比較稍长。第二,肱骨的勺状結构同上述一种很不一样。第三,股骨的“S”状弯曲很特殊。二、三两性质标志着同大的山西山西鳄比起来,較为輕便活跃,不那末呆板。第四,恥骨具有較大的恥骨孔,以及坐骨的短而厚。对作者来說,尽管其中有些标本,比較大些,但都应当把以上所列举的标本,归于这一种,較为合适。这些标本与假鳄类动物羣中其他各种相比,更为差的远,不合适。这样做就使得这些副型标本的特性,也和正型标本一样成为种的特性。

把双方面的理由加以衡量,决定确有些困难。在本文中采取的是前一种,就是把它当作山西鳄的一新种,但将来有了更充足的事实以后,不能排除这一可能性,卽应当列为一新属。这个新属的特性已見前文。

尽管黑峪口山西鳄的分布面积不如山西山西鳄那末广,但也大体上包括了同一面积,自山西东南到山西西北。宁武和靜乐未見这一种的存在。尽管比起山西山西鳄来为数較少,但絕不是稀有的。在通常的情况下,两者共生在一起。所以我們相信,两个种的地层层位应当是一样的。

黑峪口山西鳄的材料,不足完成一比較可靠的复原形象。如果上边提到那一上顎骨,的确无誤地归入这一种,那么黑峪口山西鳄的头骨构造,必定和山西山西鳄差不多,那就是具有两眼前孔。卽就腰带来說,两者的区别也不能說是太大。如果把上边所述关于恥骨和坐骨的特性不要太認真的話,两者看来更相近。总的說来,两骨都比較短而为板状,可以和山西山西鳄比,而和其他差的更多。进一步細微的区别,黑峪口山西鳄的腰带和引鳄与武氏鳄的均有所不同。特别是恥骨的区别更大。引鳄的恥骨不太扭曲,武氏鳄的恥骨的近端外侧有一显著的肩状弯折。这一新种的脊椎骨和四肢骨的特性,足够当作属的一級。虽然两者沒有层位上的区别,但看来这一新种的四肢骨,比較进步一些。

在南非,沒有关于引鳄这一类的小型种的紀录。近来在步林克所描述的一头盖骨(步,1955),为756毫米长,和原来許耐所描述的大小差不多。看来也非常难以想象,我們的种和其他头前端下垂的原鳄有什么相近的关系(尽管我們种的头部保存不好)。所有这些属,都只具有一个眼前孔。

在苏联,所有已知的假鳄类,都和我們的种有所不同。地层上比較老的 *Archosaurus* 和 *Chasmatosuchus* 在此不必予以考虑。所有其他的属都无确切的証明有两个眼前孔存在。加氏鳄按照原作者附图,确只有一个眼前孔。武氏鳄可能只有一个,尽管它的前上顎骨的形状还是可以討論的。而所謂通古斯鳄(*Dongusia*)则只有一脊椎骨为代表,难說一定。依照塔塔林諾夫,三种都是引鳄一属的同物异名。象我在以前所指出的,非洲引鳄的头骨,包括步林克所描述的新材料在内,有可能具有两眼前孔,和山西山西鳄一样,而至少加

氏鳄却只有一个眼前孔,固此很清楚,这些属不能简单地并到一起。在另外一方面，这三属比起南非的种来都很小,但却或多或少和現在的新种差不多。因此我認为无論从大小考虑,头骨构造考虑,或是地区考虑,把它們归并到一起,是十分不可能的。

从另外一方面看,我們中国的新种极有可能和苏联的属中之这一个或那一个,有較近的关系。根据以上所述的性质,由于头骨构造,加氏鳄应当首先不予考虑。 我們的种可能由于背脊椎具有第三肋骨关节痕迹,而和武氏鳄有些近的关系,但是这一层的层位显然比我們的为高,所以也难考虑。至于通古西亚鳄的层位則低一些,而它的材料非常之少,更难作进一步推判。总的来說，这些苏联的假鳄类沒有一个可以和我們的新种作可靠的对比,属和种都不能肯定。在目前还是分开对待比較合适。

## 超科:腹甲鳄类 (Chirotheriodea v. Huene)

## 科:圓甲鳄科 (Rauisuchidae v. Huene)

## 属:汾河鳄 (*Fenhosuchus* gen. nov) 新属

关于这一属的特征,以以下叙述的稜脊汾河鳄,卽本属的正型种为代表。

### 稜脊汾河鳄 (*Fenhosuchus cristatus* sp. nov) 新种

**材料**:大多数材料来自 56173 地点,都很破碎。因为头骨部分和大多数四肢骨都保存不太好,且有些疑問,所以我們主张选择一些具有特性的脊椎骨为正型。 这就是图 44A, 44A′, 44E, 44F, 44G, 44j 和 44M 为正型标本。因为这些脊椎骨有的还有些自然地連在一起，而其他的就骨头的灰白色颜色和附着的岩石来判断,也十分相似,很可能为一个体。其他在同一图上的脊椎骨，乃是选自大約有八十多个脊椎骨的代表性脊椎,用以更好的表明这一动物脊椎的整个构造。其他材料归于这一种的有:两前上顎骨,五方骨,五个不完全的下顎骨,还有一些皮甲和头后肢骨等。室內編号是 V. 2697。这一部分材料大約代表五个个体。 均产自 56173 地点。

**其他地点之可归于此种的材料**:总的說来,其他地点可归于此种的材料不多,也都很破碎,列举如下:

1. 武乡张村沟北中角沟,一个破的頸脊椎,野外号 5534,登記号 V.2499A。
2. 楡社銀郊小土沟。一左恥骨,和若干甲板。野外号 5674,登記号 V.2493A。
3. 武乡楼則峪十个洞。四个脊椎骨,脛骨,距骨,可能也有一些甲板。野外号 56159,登記号 V. 2494B。
4. 羊圈坡(确实地点不明,但归武乡无疑)。一个脛骨的近端。登記号 V. 2698。
5. "8"(确实地点不明,也可能归武乡)。一頸脊椎。登記号 V. 2699。

**特征**:一大的假鳄类,和山西山西鳄差不多大。就列入于这一种的前顎骨看来,只有一个眼前孔。方骨較碩大,其远端凸出,前面凹入的一面較浅平。下顎骨比較低,后部向外弯。頸脊椎較长，約与背脊椎同长。椎体横的压扁,腹侧有一显著的直稜，背脊椎侧边自椎体突后,有一清楚的稜向后伸，而消失于椎体后边緣前。但后部背脊椎无此现象。所有頸和背脊椎都是双平,或者微作双凹状。肩胛骨和山西山西鳄相似。 烏喙骨有較大的烏喙骨孔,或者可以成并列的两孔,肱骨的三角稜自近端急剧地下折。 尺骨的近端甚为肿大。橈骨宽。恥骨有大的恥骨孔,远端粗大。坐骨也較长。股骨細瘦作" S "状弯曲,上下两端作近于九十度的扭曲。脛骨的近端碩大。其外侧有一显著的稜。腓骨較宽。距骨有些和原蜥脚类的距骨相近。跟骨不是板状,和这一超科的相近。足掌骨短而粗壮。外皮甲板較发育,一如圓甲鳄科。

**层位与产地**:下三迭統上部或中三迭統下部。地点見上列举各项。

## 描 述

因为除 56173 地点以外,其他地点的化石都非常破碎,所以以下的記述，事实上主要以这一地点的材料为依据。象以上所指出的,这一种的脊椎骨非常富于特性。所以尽管它和山西山西鳄大小差不多,却非常易于区分。因为保存很少的头骨部分和头后骨骼,都是零散地找到的,从未有和脊椎骨有何連接，所以很可能

在归属上有些勉強，甚或有謬誤。但我們相信，大多数的鉴定应当十分可靠的。因为大多数骨骼，既可以同大小相近的山西山西鳄的相当骨骼区别开，也可以和較小的黑峪口山西鳄分别出来。不成問題，更可以和以下要討論的更小的王氏鳄分别出来。

象以下所表示的，各部分骨骼的大小变化很大，其构造在細节方面，也有所不同。所以有这一可能，即这些材料所代表的不止一种，而为两种。但是更为可能的是这只是大小上的差异或者性的不同，所以我們認为以上列举的材料都属一个种，而不必分开。

## 头骨与下颚

有两个前上顎骨（图 43，A、B），一小一大。小者可能年輕，大者成年，似乎不能列入于山西山西鳄一种，而当在此加以考虑。这一个标本为右侧，就其保存較好的情况来說，看不出有任何具有向后突起，用以分开鼻孔，和第一眼前孔的任何痕迹。其前上緣較为凸出，不象在山西山西鳄同一部分那样直，甚或微微凹入。相反的下緣的后伸的那一突起（图 43，A）相当之宽。所以我們認为后部的凹入的缺口，应当作鼻孔的前部，而不是眼前孔。在前顎骨的前上部，沒有象山西山西鳄那样上突起根部的痕迹。不幸的是鼻孔的边緣有所損伤，但下后部尚保存完好。下向后突起的外側光滑且有一浅沟，清楚地为和上顎骨前端接触之处。它的內側約有六个牙槽，为曲折的三角状骨板所隔，一如山西山西鳄那样。在第一牙槽間，尙有一新出而未用的（部分已破）牙齿，可看出前后緣的鋸齿状构造。很清楚牙齿是半槽齿式的，和山西山西鳄很相象。如图 43 A 所示，下边自前緣到下后突起后端为 118 毫米。从前顎前端边到鼻孔前緣为 95 毫米。

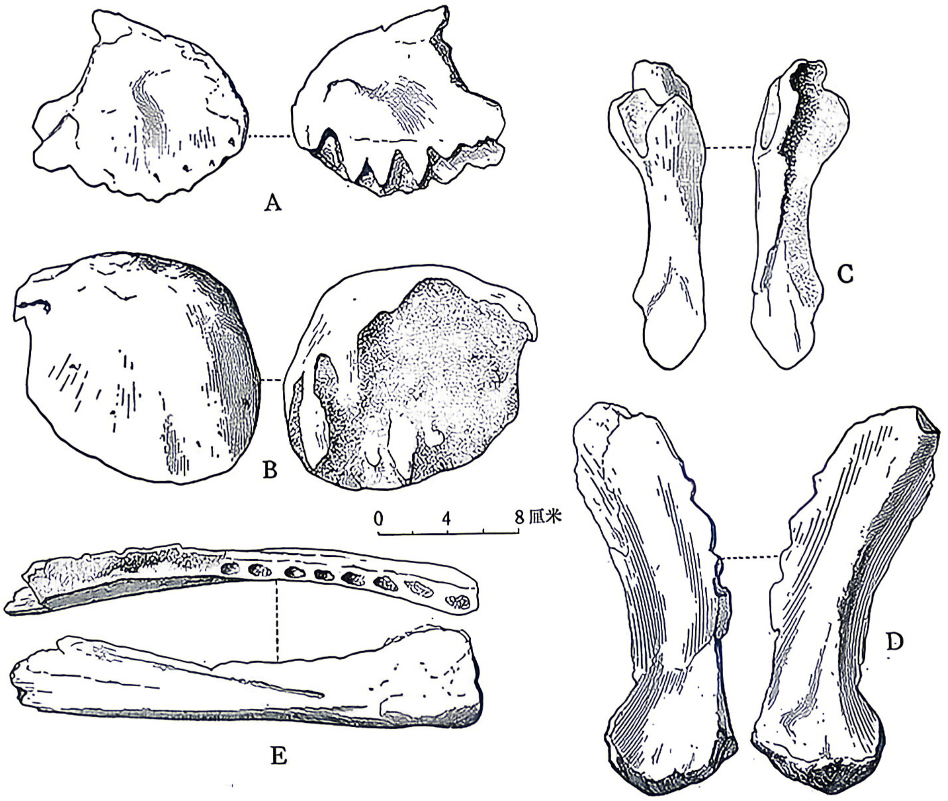


图 43 稜脊汾河鳄，比較种，稜脊汾河鳄，新属新种

A，B. 两前顎骨外观，內观； C. ? 右泪骨双面观； D. 右方骨双面观； E. 右下顎上观及側观。詳見正文。均原大四分之一。

Fig. 43 Cf. *Fenhosuchus cristatus* gen. et sp. nov. A and B. two right premaxillaries in external and inner views; C.? right lacrymal in two views; D. right quadrate in two views. E. right lower jaw in lateral and upper views. All 1/4 nat. size.

第二个較大的标本,也为右侧(图 43, B),和上一标本的性质差不多。外侧的凸出更显著,后边大部分损破,牙槽部分保存也不太好。但是前上緣的凸出情况,和上边看不出有什么上突起根部的痕迹，似乎表示它可能属于这一新种。

另外有一右泪骨,可能归于此种(图 43, C)。它的形状和山西山西鰐的泪骨很不相同。 下部伸出和顴骨的接触部分保存很好,后部弯曲部分,代表右眼眶的前部也清楚可辨。这一泪骨相当之大。

尽管有六个方骨保存,只有一个保存較好(图 43, D)。还有另外一个方骨近于完整，其前面一面尙附粘于岩石之上。至于其他方骨仅以末端为代表。就这两个保存較好的标本来看,方骨的特性可以有以下几点。两翼非如山西山西鰐成为直角交叉,而为一鈍角。远端不是直的或稍凹入,而是凸出作半圆状。在后面远端以上不是平的,而是較凹入,至于另一方面都比較平。图 43 D 的方骨很大,和上述的那一大前顎骨，以及一些較大的脊椎骨和四肢骨相称,但不适合于中等大小的脊椎和一些小的四肢骨。图上的标本，长 219 毫米，远端宽 72 毫米。

保存最好的下顎骨,为一右下顎,見图 43 E。两端都有些破坏。但就已开始加宽的情况来判断，所缺失的部分不太多。保存下的总长为 265 毫米,前端破处之高为 54 毫米,后端 42 毫米,最低处高 34 毫米。从上边看,下顎上有八个前后稍伸长的牙槽，彼此相距相当稀疏。 下顎骨的外側在上緣下不远有一較斜伸展的沟。內側的后部作为容納夹骨用的深槽非常显著。在前端麦氏沟向前伸的很远，有些象寇伯特(1952)所描述的 *Hesperosuchus* 那样。下顎骨后半段向外側弯曲,所以整个骨比起山西山西鰐来弯曲的多。总的說来，同山西山西鰐来比較,我們新种的下顎低的多,有特殊的弯曲,和发育很好的麦氏沟。 这一类下顎对于黑峪口山西鰐和王氏鰐来說,都太大了，所以把它們归之于目下描述的这一新种是十分可能正确的。 同样的理由,对于以上所描述的头骨各部分也适用。

## 脊　椎　骨

所有这一种的具有特性的脊椎都見于图 44 上。 除了少数例外，其他沒有繪图的标本性质都能表示出来。玆簡单地加以敍述如下:

**頸脊椎:** 一共約有十四个頸脊椎,其中有七个見图 44 (A, A′, B 和 C)。A 和 A′ 系正型的一部分，很可能属于一个个体。A 有两个脊椎仍然相連接，可能代表第四与第五頸脊椎。 頸脊椎肋骨的上端仍然附着于前一个脊椎的椎体突和横突面上。A′ 有三个脊椎相連,大多数的椎体突和横突都很好地保存。 可能代表第七到第九頸脊椎。

所有五个脊椎的椎体都作横的压扁,微弱地双凹,后端較深一些。腹側形成一非常显著的直稜。在椎体突后側(其位置在椎体前下端較高处),有一臃肿面,把腹稜以上的凹入部分和横突下的深凹分开。但在任何情形下,不成为一个眞正的稜,有如前部和中部背脊椎那样。横突非常之短,而向下垂。 前关节突和后关节突相当碩大。图 44 B, 为一特别变形的脊椎，可能为靠后部的頸。腹側之稜，不如 44A′ 后两脊椎的显著，所以可能更靠后一些。它的椎体突,在左側发育很好,而就破了的断面看,右側几乎沒有。 神經洞的右外側的椎体非常退化。这种情形也在以上描述的标本中可以观察到。 在 44 A，右側的横突，几乎缺失或发育不全,而在左側却很正常,左边的椎体突也比右側的特别大。44 A′ 也是如此。44 C 大約为頸的中部,代表第五或第六頸脊椎。它的椎体突相当之低。横突較向下垂。腹側的稜很显著。其他归于这一种的頸脊椎表示大体上同样性质。因为其他性质大体一样,所以我們也把几个前端略凸,甚至两端均略凸的脊椎也暫归此种。

所有在此描述的頸脊椎,和山西山西鰐相反,都平均比背脊椎为长,或至少大約相等。 所以虽大小和这一种很接近,但这一特点連同其他性质,不可能和这一种或其他种混同起来。

**背脊椎:** 一共有三十五个脊椎无疑地归于背前部。图 44 E, 44 F, 44 G 和 44 j 几个脊椎,就附着的岩石和骨头的顏色来判断，可能和图 44A 和 44A′ 为同一个个体。其他脊椎 (44, D; 44, G′; 44, H; 44, I; 44, K 和 44, L) 为背前部脊椎,保存比較好。因为其他沒有繪图的背脊椎表示大体上同一性质,所以以下的观察将主要以已繪图的标本为限。

大多数的背脊椎易于和頸脊椎区别,主要根据三角状的椎体突,和腹側的稜,椎体从不左右扁平。 側面

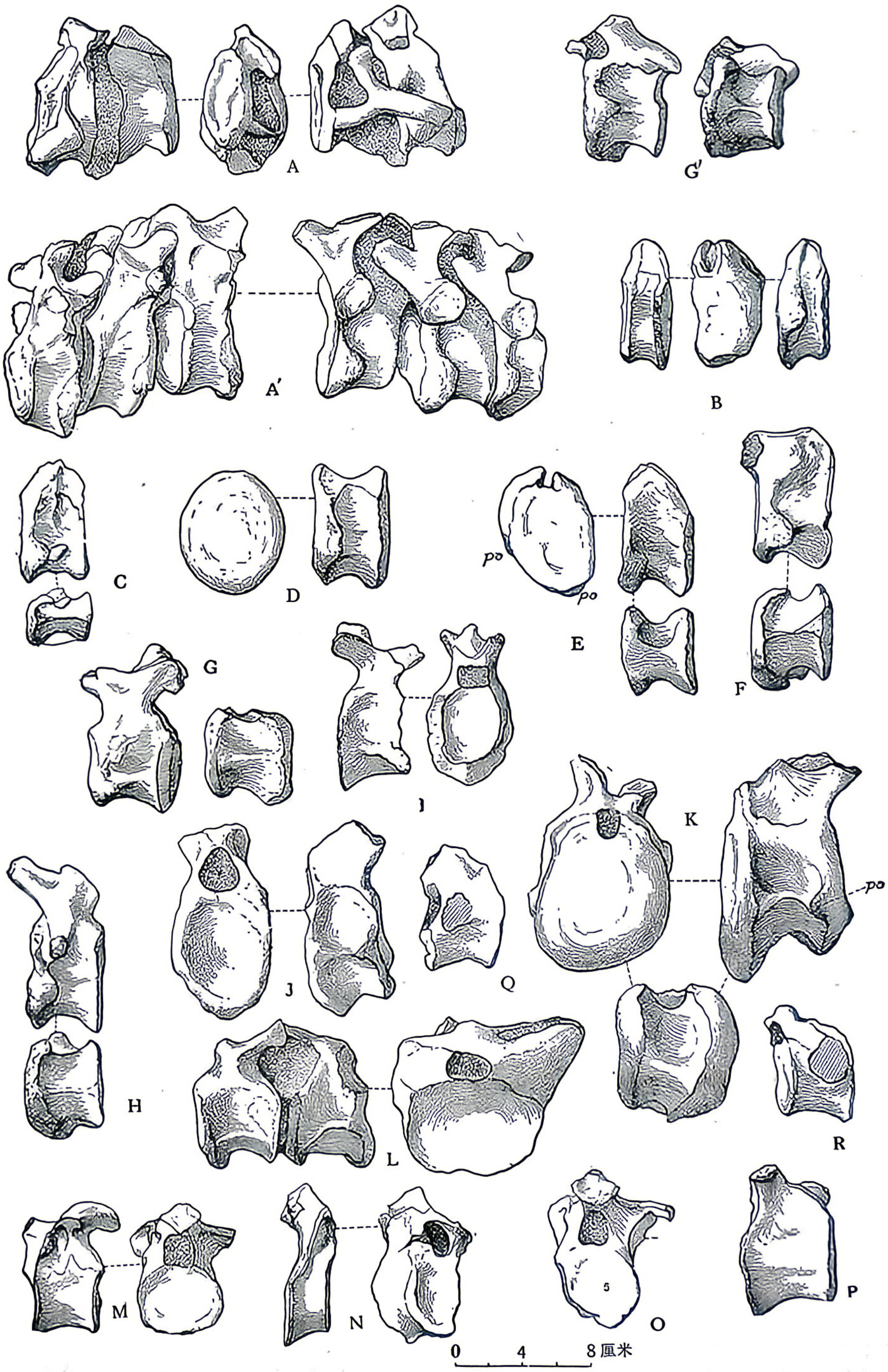


图 44 稜脊汾河鳄,新属新种

A—A'. (正型)颈脊椎; B. 病态颈脊椎; C. 颈脊椎; D. 背前部脊椎; E. 病态背前部脊椎; F. 背中部脊椎; G—H. 背中部脊椎; I. 背后部脊椎; J—K. 背中部脊椎; L. 背后部脊椎; M. 可能为背后部脊椎; N. 幼年个体的腰脊椎; O—P. 尾脊椎; Q. 第一荐骨脊椎; R. 第二荐骨脊椎。詳見原文。均原大四分之一。

Fig. 44 *Fenhosuchus cristatus* gen. et sp. nov. A—A'. (the type), neck vertebrae, A in right, anterior and left side views and A' in left and right side views. For details see text; B. a pachyosteous neck vertebra in three views; C. neck vertebra in left side and ventral views; D. anterior dorsal vertebra in anterior and left side views; E. a pathological anterior dorsal vertebra in anterior side and ventral views. Note the displacement of the parapophysis and the asymmetrical development of the centrum; F. middle dorsal vertebra in side and ventral views; G. middle dorsal vertebra in left side and ventral views; G'. middle dorsal vertebra in left side and ventral views; H. middle dorsal vertebra in left side and ventral views; I. posterior dorsal vertebra in side and posterior views; J. middle dorsal vertebra in anterior and right side views; K. a middle dorsal vertebra somewhat displaced and abnormally developed, probably pathological, in anterior right side and ventral views. Note the unusual development of the parapophysis and the asymmetrical ventral side; L. two posterior dorsal vertebrae probably the same individual as the preceding one in side and anterior views; M. probably posterior dorsal vertebra in side anterior views; N. a deformed lumbar vertebra of a young individual in anterior and right side views; O. caudal vertebra in posterior view; P. a middle caudal vertebra in side view; Q. sacral vertebra I in left side view; R. sacral vertebra II in right side view. All in 1/4 nat. size.

椎体突后的稜在靠近頸的部分不怎么显著,有时甚至难以区别。实际上可能有的真代表頸脊椎的最后部分。中部的背脊椎椎体突向上移,离开椎心,而側面的稜比較显著。椎体突一般的很低。横突如保存的話,比頸脊椎的还短。有几个脊椎沒有椎体突的痕迹,可能属于前部脊椎的后部,但是側面的稜,仍然发育很好。前关节突和后关节突仅在少数几个标本保存,无何突出的特性。背棘多未保存,但由断破切面来判断,似不很发育。

象頸脊椎一样,許多背脊椎也是反常的发育。如图 44 E 和 44 K,其两边不对称。另外有些脊椎,其一边的椎体突和側面的稜,照常发育,而在另外一边却变小或很不发育。

按照大小,似乎可以分为三类背前部脊椎。大多数为成年的,一小部分小的可能为年輕的,而有些却非常之大(图 44, K 和 44, L)。

**背后部或腰部脊椎**: 腰部脊椎,比較不多,在大約二十个腰部脊椎中,見于图示的有二,卽图 44M和 44N。图 44M,如上所述,可能与其他正型脊椎同属一个体。图 44N 代表一年幼个体,且有些变形。腰脊椎的特性是,椎体有些左右扁平,而腹側有多少可辨的稜。在背前部脊椎发育很好的側稜,在腰脊椎也无痕迹可寻。椎体突向上移到椎体以上以一薄层和横突相接。横突向外伸,几乎是水平的,当然也較小。当然很不容易判定这些脊椎在脊柱中的准确位置,但是那些椎体短比椎体拉长的要位于較前一些,似乎很清楚。有一标本,其椎体突和横突差不多合在一起成为半月状輪廓,似乎属于在荐骨脊椎紧前的一个脊椎。也代表一年輕个体。

**荐骨脊椎**: 一共有三个第一荐骨脊椎,一个第二荐骨脊椎,可归于此种。其中保存好一些的見图 44 Q 和 R。前者为 Sc.I,后者为 Sc.II。在大小上两者都很接近山西鱷的小的一种(黑峪口种),但和它不同处在于椎体横向压扁,腹側也有直稜。事实上这是我們材料中唯一的荐骨脊椎,具有腹側直稜,可以很容易地和其他三种假鱷类区别。另外它的前端比后端只稍微大些。两端左右变窄,而非如其他三种之加宽。所有荐骨脊椎看起来对頸和背脊椎来說較小一些,可能属于年輕个体。

**尾脊椎**: 归于此种的只有几个尾脊椎(图 44, O 和 44, P)。这些脊椎的准确位置很难定。比較短的,可能归尾前部(44, O),比較长的,可能为尾中部。沒有一个保存着脉經弧和以上部分。椎体的腹側,有的具有直的稜;有的有一浅沟,两边界有不很清楚的稜,这或因位置不同而异。椎体并不照山西山西鱷那样,中部十分收縮。有的脊椎可以看出腹棘所附着的面。

**肋骨**: 除了上述附着在頸脊椎上的肋骨上端外,沒有很可靠的肋骨发見,除非有一些肋骨混入于山西山西鱷中(图 25)。頸肋骨的两头分的很开。关于荐骨脊椎的肋骨有两个左側,一个右側,見于图 45 A—C。这几个都是第二荐脊椎肋骨。其一般构造大体相同,但厚度相差很大。同脊椎骨接連的一端很厚而窄,而同腸骨接連的一端薄,而特别加宽。右边那一个的远端非常之薄,虽然它的大小和其他差不多,但可能代表一未成年个体。这个骨的形状見附图。

## 肩 带 与 前 肢

**肩胛骨**: 很难判定无疑的属于这一种的肩胛骨,因为不容易和山西山西鱷的分别。这里所选定十分可能归于此种的肩胛骨(图 45, D),可由以下几点和上述的种区分,卽比較上不那末碩大,骨身的中部很收縮,远端不那末作断切状。比較完全的肩胛骨表示远端远比近端为窄,也或許可当作与之区分的一个特性。这一种肩胛骨的大小,大体上介于两种山西鱷之間。

**烏喙骨**: 56173 地点的一个左烏喙骨(图 45, E),尙附着于汾河鱷型的背脊椎上,所以十分可能卽属于此一种。它和山西山西鱷的区别在于有一个大而穿透的烏喙骨孔。而这个烏喙骨作具圆角长方形輪廓,与山西山西鱷之三角形烏喙骨不很相同。长度 111 毫米,宽 91 毫米。另外一烏喙骨地点为 56159 (图 45,G),其腹边破損,也有一大的烏喙骨孔,其輪廓也作长方形。它和許多汾河鱷的脊椎骨在一起,看来归于同一新种,也无疑問。另外有第三个标本(56173)(图 45, F) 在烏喙骨孔的位置上,有一深窝,但未穿透。另外还有两个未穿透的深窝。一在近肩胛骨边的內側,另外一个,在外側作为內側那一大孔向外延伸。在 56159 地点,那一烏喙骨的內側也有相似的凹入。此等性质,从未見于山西山西鱷一种,而只能归于这一新属,或者看

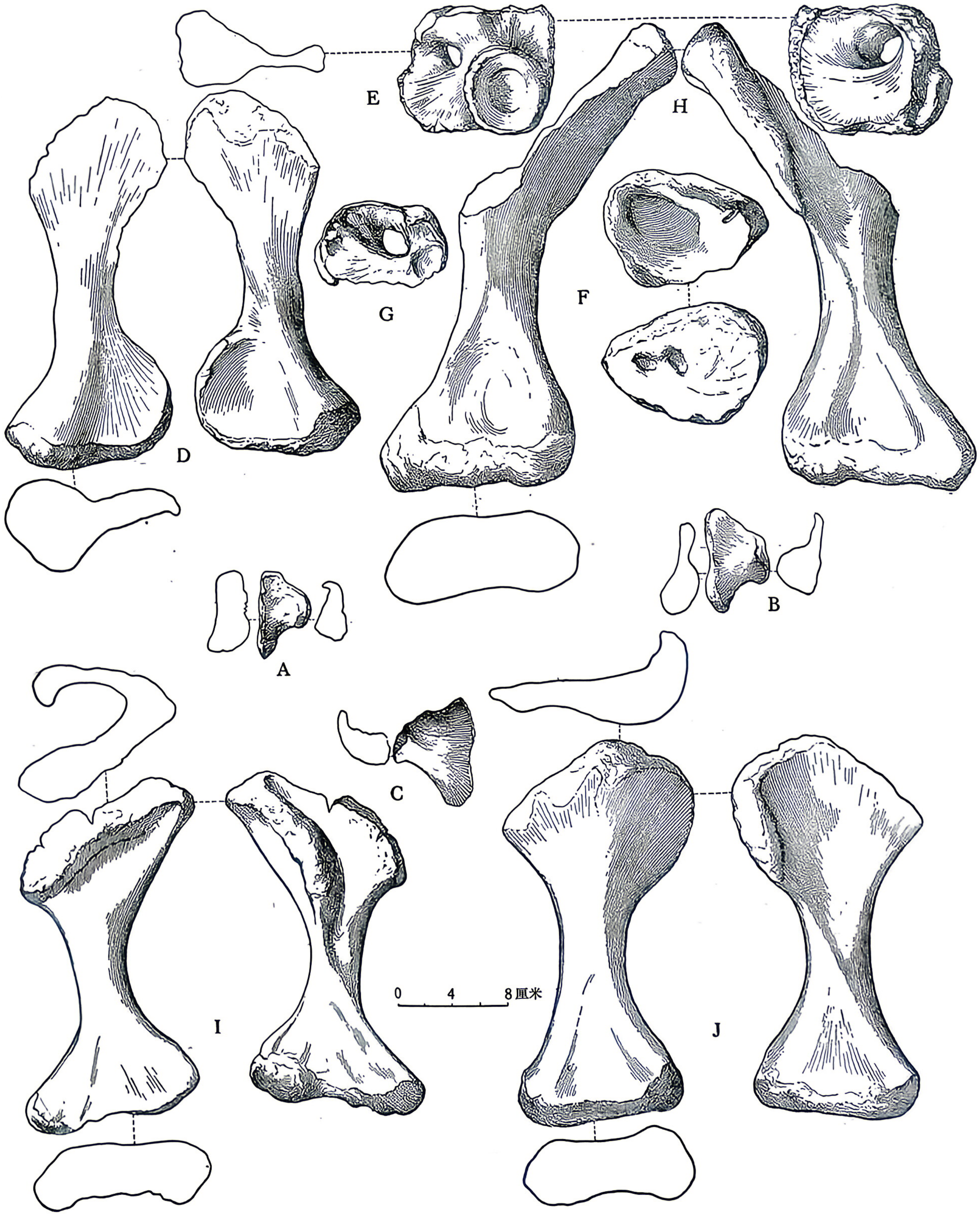


图 45 稜脊汾河鳄,新属新种

A—C. 三荐骨肋骨； D. 左肩胛骨内外觀； E. 右烏喙骨双面观； F. 右烏喙骨双面观； G. 右烏喙骨外觀；H—J. 三肱骨双面观。詳见正文。均原大四分之一。

Fig. 45 *Fenhosuchus cristatus* gen. et sp. nov, A—C. three sacral ribs of different size and stage of ossification; D. left scapula in inner and lateral views with outline of both ends; E. left coracoid, in two views with outline of the scapula border. This specimen is in connection with a vertebra of *Fenhosuchus cristatus* type, so that its belonging to this species is quite probable; F. right coracoid in two views note the complication of the coracoid foramen; G. a right coracoid with the big coracoid foramen in external view, from locality 56159 (V,2494B); H, I and J. three humeri in two views. Note the unusual deformation of I with the perculiar shape of the proximal end as compared with J. It is pathological. All 1/4. nat. size.

作是一种反常的发育，或者当作另有这一属的第二种的存在，象脊椎骨所已表示的。我們目下采取前一假定。

**肱骨**：五个比較完全，若干近端和远端的碎片，其中有三个見图 45 H—j。肱骨大小差别很大，可能因年龄不同。同山西山西鳄比起来，主要特性是，近端的关节部分，和三角稜部分作近于九十度的弯折，三角稜下

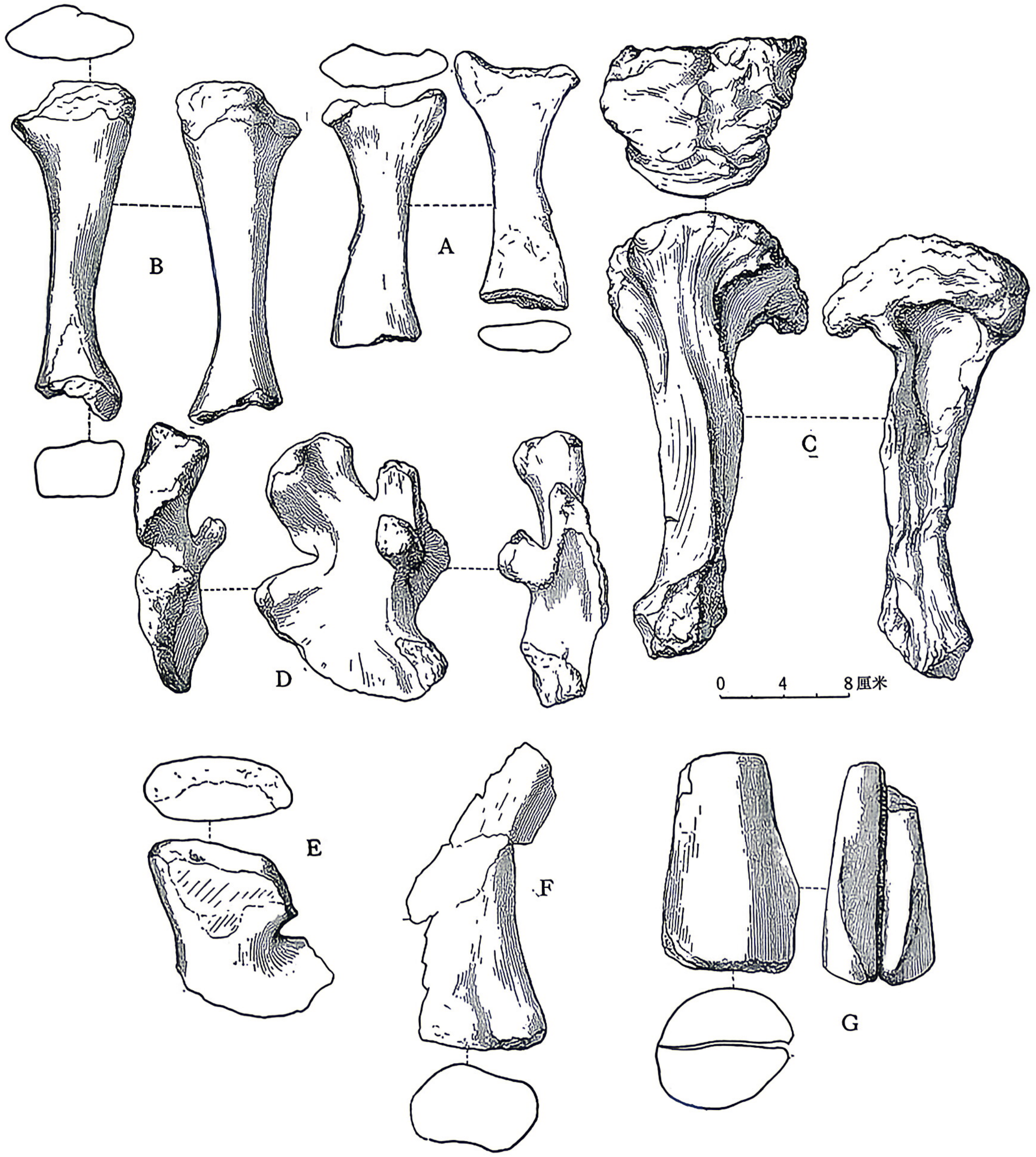


图 46 稜脊汾河鳄，新属新种

A. 一变形的橈骨；B. 左尺骨；C. 可能为一变形的右尺骨；D. 左肠骨；E. 左耻骨；F. 右耻骨；G. 坐骨。詳見正文。均原大四分之一。

Fig. 46 *Fenhosuchus cristatus* gen. et sp. nov. A. a deformed radius; B. left ulna in two views with the outline of both ends; C. probably a right ulna in pathological development; D. right ilium in posterior inner and anterior views. Probably pathological. At the external side a right quadrate adhering to the acetabulum of the specimen which is the same structure as the quadrate referred to this species, indicating that the ilium way belonging to the same form; E. proximal part of left pubis from 2574 (V. 2493A) in external view; F. distal part of a right pubis in ventral view; G. distal ends of both ischia from Hutaikou, Tachang, Ningwu (V. 2302A). All 1/4 nat. size.

垂不大,低远高于骨干的中点。最特殊的例子为图45 I 这一标本,其弯折程度竟成一銳角,而三角稜远部非常加厚。这个标本并无受挤或变形现象,可能是較异常发育的表現。另外两肱骨的三角稜,位置較高的情况,也多少可看出,近端部分的弯折也非常清楚。图45H的近端的內側已破裂,这个标本較大一些,三角稜也較低,或者代表一大的个体,或者代表一新的种。

**尺骨**: 图46 B,代表一左尺骨,很可能归此一新种。这一标本的两端,稍有損坏,比起山西山西鳄的尺骨来碩壮一些,較直。骨干也較厚。

另外一个特別大,而构造也非常特殊的右尺骨(图46,C),也可能归于此种。它的近端非常的粗大,但向下驟然收縮。在近端下,前部同外側凹入部分,非常的深而显著。尺骨的骨干甚为弯曲。由近端向下一直变得較为細小,只有远端部分,稍微加粗一些。这一部分稍有損伤,但其扩展情况,还可以清楚地看出。另外一尺骨的末端,保存完好,表示末端显著地凸出,这两个尺骨的构造和上述那一左尺骨很不相同,但仍可能归于一种。因为其中之一必然是不正常发育。另外至少有三个尺骨的近端,和那右尺骨构造一样,只是小一些,也归入此种。

**橈骨**: 只有一个左橈骨归于此种(图46,A)和山西山西鳄比起来,两端宽的多,所以也显得碩大一些。

## 腰 带 和 后 肢

腰带部分的骨骼,保存非常不完全。

**腸骨**: 沒有一个可靠的骨能够无疑的当作这一种的腸骨。很特别的一左腸骨(图46,D),是一个非常变形而不正常发育的标本。它和一个归于此种的方骨連在一起,可能表明两者之間有較近的关系。它的恥骨和坐骨边緣比較能分清,但仍象山西山西鳄一样,成一鈍角的角度[另外有两个归于此种(未繪图)的标本,恥骨边和坐骨边分的更清楚一些]。最特別的是前后两端的形状。前端的边緣,不怎么完全,但在骨的內側卽第一荐骨肋骨的印痕处,有一特殊的向內伸的突起。腸骨的后端,也很特別地加厚,也有一內側面凸出部分。也看不出有任何第二荐骨肋骨的痕迹。腸骨的上边未保存,但很清楚地和后端加厚部分分开。整个骨未表示有任何变形或挤压,所以这些特殊的形状,必須当作是原有的結构。但是我們認为这只是一个变形的发育,而沒有任何分类上的意义。因为这一腸骨的骨板部分未保存,但髋臼部分与所有假鳄类基本上相同,所以很清楚,这些标本,不够作进一步詳細鉴定。

**恥骨**: 虽然恥骨保存也很差,但是从那两个繪图的标本,可以看出,我們这一新种的恥骨构造和山西山西鳄的恥骨,大不相同(图46,E)。一个标本是左恥骨的近端部分,产自榆社銀郊小土沟(野外号碼5674,V. 2493A)。这个标本,具有一較大的恥骨孔,在近端和腸骨接觸的面,相当之窄,并和髋臼面部分(有些殘缺)清楚分开。和坐骨接触面,保存完好,并且恥骨孔的位置非常靠边緣,甚至一部分超出边緣以外。这个骨的末端未保存,但有理由相信,在远端以上有相当长的柄。这单一的恥骨孔,令我們相信和許耐所描写的*Stagonosuchus nyassicus* (1938)很为相似。另外一标本(56173)(图46,F)代表一右恥骨的末端。外側的加厚部分,較为弯曲。后前側的較游的部分有些损坏,但其一般輪廓尚大致可辨。远端非常之厚。其輪廓作长方形。把这两个标本的性质加在一起来考虑,說明这一新种的恥骨是具有长柄的。另外有三个恥骨的远端,比較小一些,可能代表年幼的个体。

**坐骨**: 也保存的不多而殘破,都是一些近端和远端的碎块(包括56160的一个,V. 2700,和宁武二馬营虎台沟的一对远端NWC, E. D. V.2502)。近端和远端都表示这一种的坐骨具有拉长的柄,和山西山西鳄的坐骨很不相同。虽然沒有一个近端是十分完全的,但那加宽的情况可以清楚地看出,这和在以下要描述的王氏鳄有些近似。坐骨的远端有四个,有些相当的加粗,其归于这一种,并不是完全沒有疑間的。保存最好的坐骨远端为图46G所示的来自虎台沟那一标本,其左右两个尚自然地連在一起。这一对坐骨,从远端起只比較輕微地向上变窄,其远端面为半圆状,两个紧密地相連。具有清楚的微斜的稜的一面,为前下側。远端的长度为42毫米;两者的宽为36毫米。这个标本比王氏鳄的坐骨大的多,又和山西鳄两种的坐骨大小相同,其应归于此种是十分可能的。

总的說来,这一新种的整个腰带骨,是十分不完全的。有一些,其归于此种,并不是完全清楚,特别是关

于腸骨。但是由于恥骨和坐骨的一些特性十分显著,所以其应归于这一种,看来是十分可能的。他們的大小和山西山西鰐可以相比,但形状却差的很远。 除非是除了这一动物羣,还有另一种假鰐类存在的可能性以外,他們归于这一种是十分自然的。

有一个完整的左和三个右股骨(图47, A—C)。此外还有很多两端碎块。这个股骨和山西山西鰐不同处,在两端之間有較显著的扭曲。近端宽面和远端宽面,差不多成为大約九十度的轉曲。除了右股骨从外側看有"S"状的弯曲外,其他的比較为直。股骨的两端的輪廓相当不一致。第四圓錐不怎末发育,左边的一个(图47, A)和右边的小一些(图47, C),其骨干中部显然左右挤扁,而另一大的右边股骨(图47, B),扁平程度比較稍差。有些零散的近端和远端股骨,相当之粗大。有些是否应当归之这一种还不无疑問。另外新的一种的存在的可能性,不能百分之百的排除。

**脛骨**: 有两个左近端,一完整的右側,一右近端和許多两端的碎块(图48, A—D)。这一完整的右脛骨,比其他标本小一些,但是比黑峪口山西鰐的脛骨,还是大的多。近端下、外、上面部分非常凹入,可能受有挤压,远端也有些损伤。这个脛骨,相当之直,其近端面很斜,而长与宽大致相等。另外三个繪图的标本都大一些,可能代表大的个体,或成年的个体。它們的近端面形状相当变异,但都或多或少地作横向的压平。这几个脛骨,甚至比山西山西鰐还大一些。但如把我們的标本,和大多数 Stagonolepids 一类的脛骨来比,还是比較小而細的。把保存很差的 *Stagonosuchus nyassicus* Huene (1938) 来比,两者的脛骨非常相近。特别这一完整右脛骨。

腓骨有三个完整的,还有一些近端远端的碎块。这些骨的归属也不是完全沒有問題。有两个見图48 E和F。这个腓骨非常的宽而短,比起一般的腓骨来,显得宽,也显得薄。在輪廓上和归于山西山西鰐的幼年股骨有些近似之处。若干近端头由于有发育很好伸出部分使人想到脛骨。但是究竟不很发育,而股骨的清楚分开的脛骨和腓骨关节,在这一种非常清楚,但却在这些标本上看不見。所以我們認为在此所列的骨骼,还

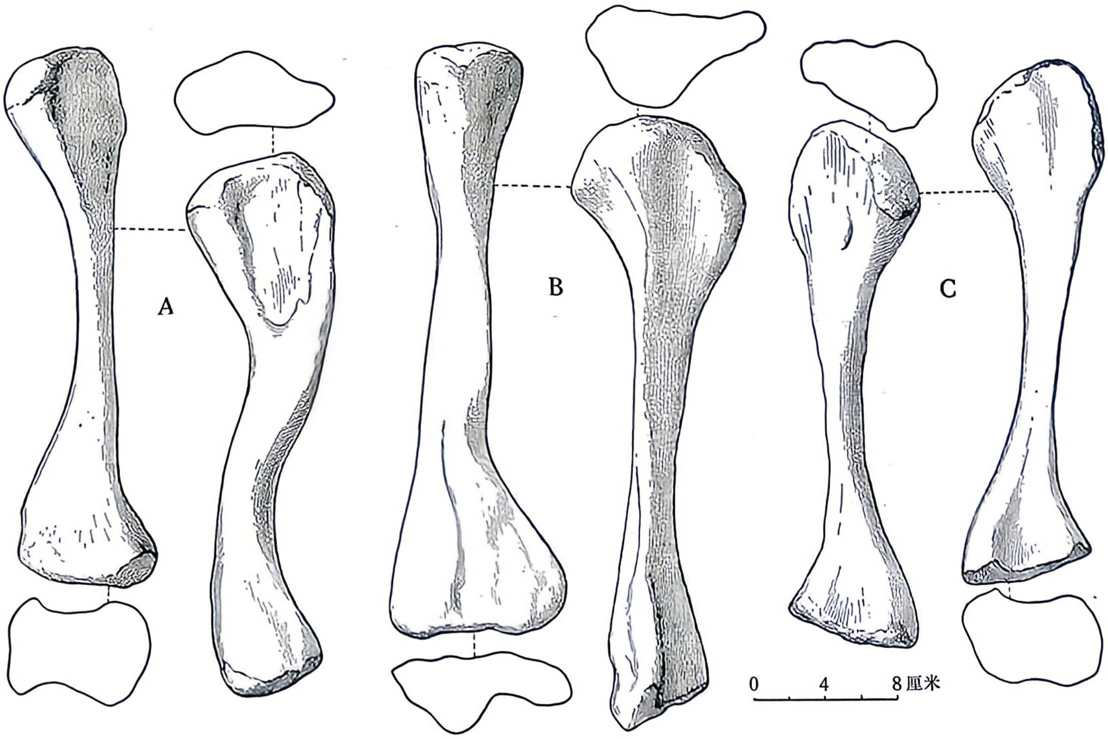


图47 稜脊汾河鰐,新属新种

A. 左; B. 右; C. 右股骨双面觀。詳見正文。均原大四分之一。

Fig. 47 *Fenhosuchus cristatus* gen. et sp. nov. A. left; B. right and C. right femora in two views with outline of both ends. 1/4 nat. size.

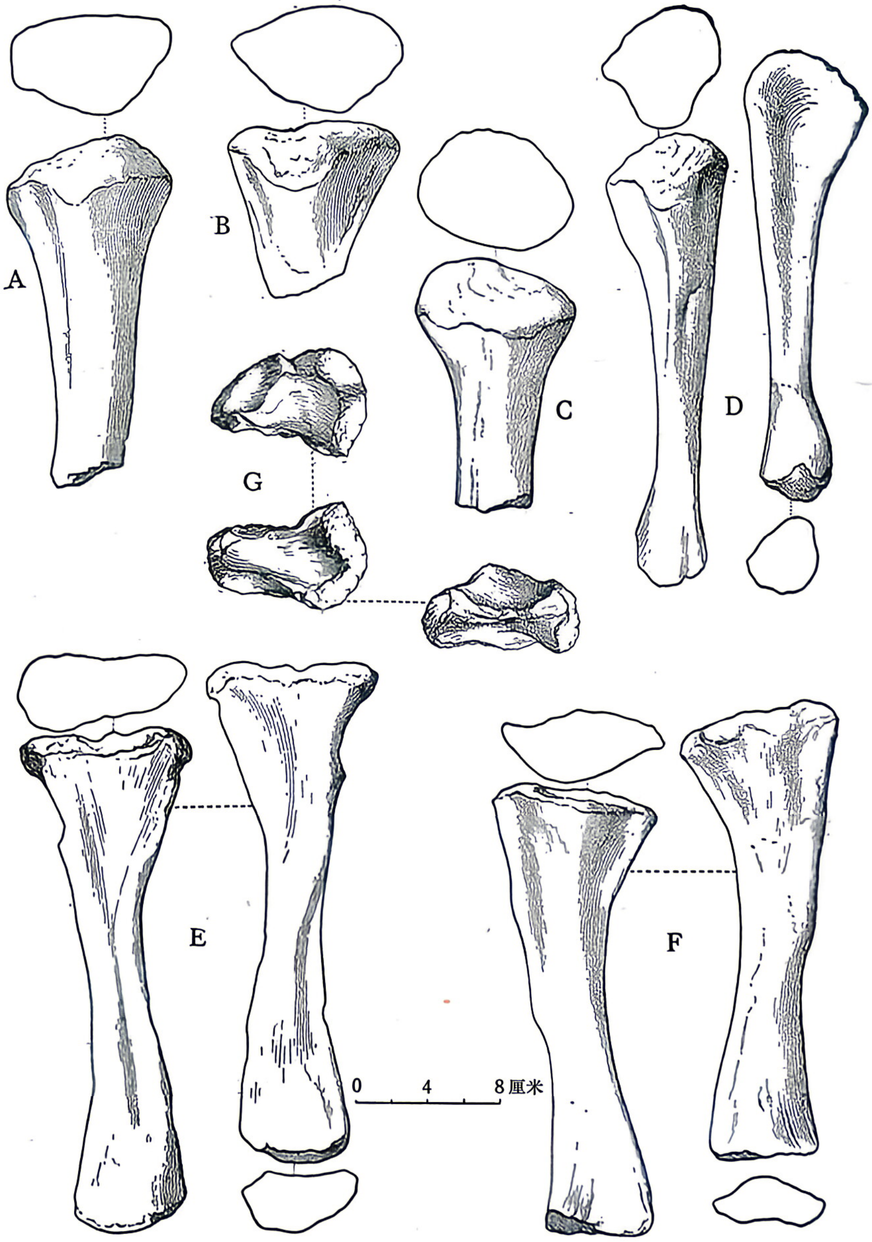


图 48　稜脊汾河鳄，新属新种

A—D. 四脛骨各面视，詳見正文；　E—F. 二左及右(F)腓骨双面观；　G. 右距骨三面观。均原大四分之一。

Fig. 48 *Fenhosuchus cristatus* gen. sp. nov. A—D. four tibiae in different views with the outline of the preserved ends. For details see text; E—F. two left and right (F) fibula in two views with outline of both ends; G. right astragalus in dorsal, ventral and posterior views. All 1/4 nat. size.

应当定作腓骨，而不是其他。它的短而宽的情形特别突出，但是与上述的脛骨可以配得起来。这样短的下后肢情况，也和上述的同一种的前肢下部的短宽情况相符合。

## 手 骨 和 足 骨

一共有六个骨骼(图 49，A—F)可以认为是手掌骨。短而宽的几个(A 和 C)，輪廓較呈斜方形，主要由于近端外側和远端內側較为突出地伸出之故。另外三个手掌骨，定作 Mtc. III (图 49，D)，Mtc. IV (图 49，E)和 Mtc. V (图 49，F)。这些骨都很碩大，两端甚为粗壮。作为足掌骨，显然太短。平均来讲，这些归于此

种的手上骨骼比起山西山西鳄来稍大一些，尽管这一新种的最大的前肢骨，并不比山西山西鳄者大多少。在构造上足骨和 Aetosauridae 中的足骨很不相同(瓦尔克，1961)，主要由于短瘦。相反地却和归于山西山西鳄的有些可比之处。

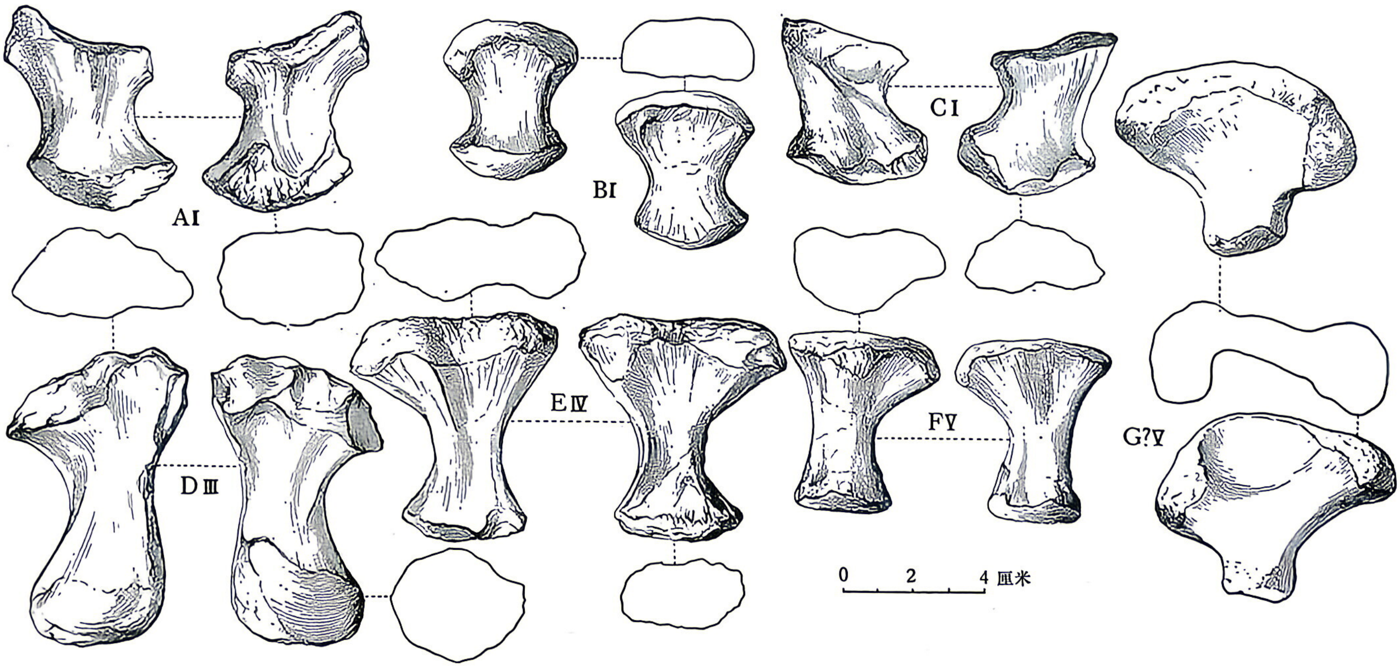


图 49 稜脊汾河鳄，新属新种

足掌骨的双面观及两端輪廓。I—V. 表示趾数。詳看正文。原大二分之一。

Fig. 49 *Fenhosuchus cristatus* gen. et sp. nov. Meatarsals. I—V indicats the number of the digit. 1/2 nat. size.

在山西山西鳄的描述中所說的若干球形骨，可能为足跟骨，或者有些可归目前这一种。但是无法把两者清楚地区别出来。

**距骨**：关于距骨，在 56159 地点所获得的一个(V. 2494B)特別値得加以重視。因为这一标本是和无疑地属于这一种的若干脊椎骨和四肢骨一起找到的，因而十分可能也属于这一种。此为一左距骨(图 48, G)。这个距骨的一般形状，和以前所述归于山西山西鳄的距骨，頗有可以比較之处，但仔細研究起来，有以下的一些区别，即比較大一些，背侧沒有那斜的稜，相反却有一弱的横的稜，內侧一端，不怎末发育，腹侧有一凹入面。

**跟骨**：有两个属于这一骨的标本在此叙述，至少其中之一归于此种。

一个标本，見图 34 C，几乎具有大多类山西山西鳄跟骨的性质。但它非常之厚，难以說是板状。两端微有錯移，所以方形輪廓不大清楚。最特別的是如該图所示，其后面不是一凹入的面，而为在下端有一特别的切面。这个切面对于形成一好象距骨上面那样有一斜的稜有关。这样情况好象表示和其下的一个足跟骨有不正常的接触关系。两端清楚地扭轉。这一跟骨比起山西山西鳄的跟骨来，是相当特殊化的，或者可作一发育不正常的个体归于此种，或者归于目下所描述的这一种。

第二跟骨为右側。也作方形輪廓。如图 35F 所示。前边的一面的靠內的一端，有一清楚的肩状形。在腹面，有一中横的稜，自外侧向內，約成一"T"形以与上述的肩形相接。此外，这一面比較平，甚至微作凹入，但为此一稜所分开。特别有兴趣的是，在背側的外端那个球状面的发育，显然为与腓骨远端接触之处。在內侧向后伸的薄叶状部分(与球状部分，为一沟所隔)，只是和距骨接触处的延伸部分，而和象下一种的跟骨的具有一茎状突起处完全不同。內側一面为三角状輪廓。实际上这个三角状由两不同面組成。一为凹入部分，在那薄叶状部之下，与足跟骨之上端接連；而另一面稍凸出，約在上凹入面之外和距骨接触之处。象这样

一个跟骨，比第一个描述的跟骨更为特殊而复杂。这个跟骨和 *Typothorax* 以及与之相近的种类的跟骨，有些相似，只稍进步一些。但在細节方面，和这些种还有些不同，还較为原始。即就在一般构造上看，不可能把这个不同的跟骨归于一种。初步意見是这一个跟骨可归此种，而前一个跟骨，或者表示还有另一新的假鳄类存在，或者作山西山西鳄的一个反常的发育的标本。

## 外皮甲板

山西山西鳄和这一新种經常在一起发見，但前者多而后者很少。問題是所有的一些少数的甲板应当归那一种。由于以下的一些原因，我們把多数的甲板归于此种，而另一些少的，則当作以下要描述的另一个假鳄类，即王氏鳄。(1)和山西山西鳄最相近的非洲引鳄，一般当作沒有甲板，尽管有人怀疑（Kuhn, 1961）；(2)从56173一个地点，有超出三十个以上的山西山西鳄，而自同地点只大約有五个个体属于目下的种，而甲板相当之少，这与后一情况相适应；(3)如以下所得的結論，这一种十之八九归圓甲鳄科，所有这一科的种，都具有或多或少发育的甲板；等等。

除了很多的破碎的甲板以外（有些很容易和头盖骨碎片混淆起来），大約有二十个无疑的甲板归到此种。大多数甲板見图50。这些甲板大体上可以分为四个类型。第一类（图50，A—G）大体上为四方形或长方形輪廓，背面凸出，而腹面凹入。其靠內的一端較厚，同其对面的一个接触，显然是松弛的。除了图40D和50E，因为保存太差无法确定以外，其他均清楚地在背側有較陡和較平的两部分。那較陡的部分，如保存好的話，可以看出具有粗的不規則的皺紋状或疸痕状构造。这应当为暴露于外的部分。平的部分，較为光滑，

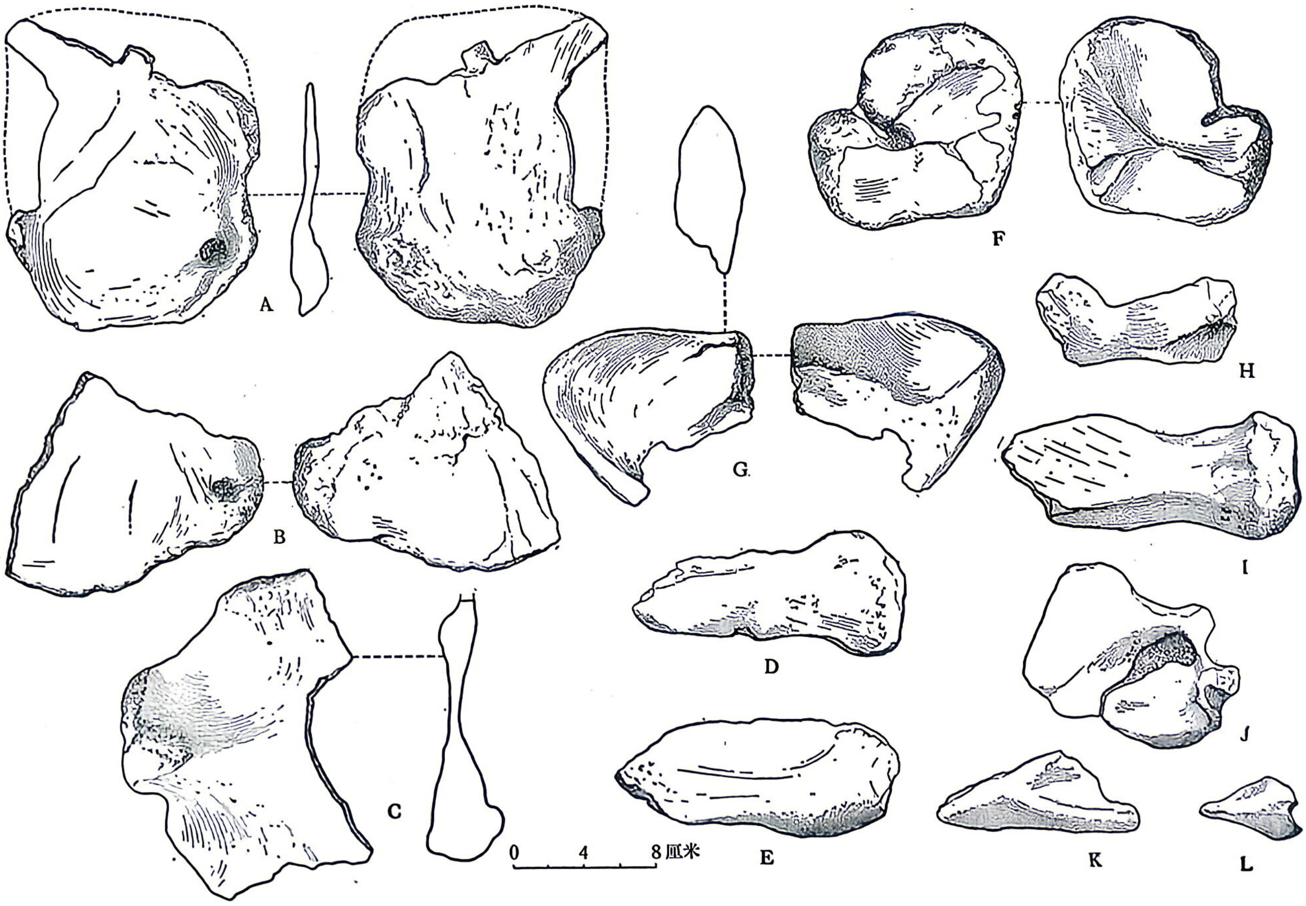


图50　稜脊汾河鳄，新属新种

甲板，詳見正文。原大四分之一。

Fig. 50 *Fenhosuchus cristatus* gen. et sp. nov. Various dermal scutes. For details see the text. 1/4 nat size.

可能为其前的甲板所遮盖。

图 50 A 是保存最完全的一个,几近完整。这个骨板属于右侧,比較薄,而內側的加厚处,也不太突出。在这加厚部分以下,即腹侧,有一橢圓而未穿透的孔。在这一端以前,为一微弱的凹口所隔,該骨仍还稍厚一些,然后向侧面漸漸变薄。后部陡的一面很粗,有瘤痕状結构。在外緣,甲板向下弯曲。腹侧一般光滑,但有几个不規則的浅沟。

图 50 B 和 50 A 差不多,不过不如它的完整。內側也只輕微加厚,腹側的孔比較小一些。可能和图 40 A 为同一边,即右边。

图 50C(自 5674 地点,V. 2493A)为一甲板,其內側保存的特好,而外侧则已破損。当作后面一面的陡的部分,具有清楚的瘤痕状或皺紋状构造。內側的面非常之厚作三角状輪廓。在这以前,也如图 50 A 一样,为一缺口所隔,有另外一加厚的部分。这一标本,代表一成年个体。

图 50D(自 56160 地点,V. 2700),似乎只代表这一类甲板的后部,前部缺失。骨面也有細的紋飾。在厚的部分以下,也有一深的凹陷,好象表示那已消失的孔的遺迹。在另一端也如图 50 A 一样,急驟地向腹侧弯曲。

图 50E 保存还要差一些,但也象是代表如 50 A 的一部分,宽的一端,代表外侧。

图 50 F 和以前所描述的甲板,除了有方形輪廓,均不大一样。除了一边,可以当作是后侧一边外,其他三边均多少有些加厚。在一角上有一缺口,也相当之厚。背面具有一分叉的清楚的稜。腹侧較凹入而光滑。这一骨板有一些和上述各骨板相同的地方,但也有很显著的区别。由图上可以看的非常清楚。

图 50G(自 56172 地点,V. 2495)为一近于完整的甲板,只有后部(?)有损坏。这也是一个四方形的骨板,比前一个稍大一些。除了內端和后外端稍厚以外,其他部分均較薄。另外此骨板中部显著的弯折,具一横的稜,稜的一边較陡,一边較平(陡的一边当为后部,所以此骨板应属右側)。这个稜向外向前伸,在此部分,骨板作隆起之状。骨板的稜以前和稜的斜面以后的两边,都比較平滑。腹側凹入一面,也比較平滑。在內端的下方較后一些,也有一凹陷部分。从这一边看(腹側),外側的厚的部分較平,而具有沟状,似代表眞正的关节面。

第二类甲板以图 50 H—I 为代表。保存比較好的图 50 I 近于完整。这一类甲板的特性是为横的拉长的长方形,而內側的一端特别加厚。两个构造很相似,而大小不同。在图 50 I(56160 地点,V. 2700),內端部分特别发育,而向外端驟然变薄。然后微見收縮,然后再継續向外側稍加宽而薄。骨的后外部不完全,但外側为圆状边緣是毫无疑問的。在厚的一端的外側,位于横的稜以前,有小凹陷部分。这个横稜比較不显著,但也把骨板分为前部較平,后部較陡的两部分。一部分有輕微的皺紋可辨認。在腹側甲板作凹入状。这个标本,清楚地表示后部窄而較陡的一边为邻近的一个所掩盖。

第三类甲板,仅由图 50 J 为代表。这个标本有两甲板仍然自然地相連。內側一端,两者之分界不太清楚,可能愈合在一起。前边一个的內端非常之厚,継以很显著的收縮,然后作肩状的扩展。实际上并沒有清楚的横稜,但有微弱的相似的发育,把骨板分为前后两部分,还是可以观察出来。甲板的外前边是比較直。后边的一甲板比較小,內端根部无收縮。这个甲板也能分为前后两部分,后部較陡,一如以前描述的其他甲板。內端关节一端构造特殊,有一深的几乎是直竖的沟。

第四类甲板以图 50 K—L 为代表。这一类骨板为三角状,具有一显然朝侧面的尖端。

以上这些甲板有不同的形式,来自不同地点,保存也不太好,而且都是零散的找見,所以对鉴定其具休位置,和彼此关系,沒有許多話可講。但是以下几点,似乎是很清楚的。这些甲板和 Aetosauridae 一科的各属(Walker, 1961, p. 185)的甲板大不相同。显然也同 Erpetosuchidae (Newton, 1894) 不相同。所有这两科的各属,全身为甲板所包,而甲板是长方形輪廓。有許多事实表示,我們这一种的甲板結构,不怎么发育,起碼不是全身的,甲板的外側(包括第二类在內),是較宽的。我們这一种的骨板似乎可能和 Rauisuchidae 这一科有些相近的关系(这一科包括 *Rauisuchus, Prestosuchus* 和 *Stagonosuchus* 等属)。支持这个說法的还有外側作圓边的这一性质。在脊椎骨和四肢骨方面,我們这一种和以上各属之一的 *Stagonosuchus* 有些相近。遺憾的是关于这一属的甲板一无所知,因之不能进一步作比較。虽然我們还未确定这些骨板在身体上

的具体位置,并作出复原图象,但很有可能,第一与第二类甲板属于背的前部,第三和第四类属于較后部或尾部。在討論到第二个具有甲板的种时,还要涉及到这个問題。

关于这一新种的尺度大小,見表13(頁167)。

## 鉴定与討論

象以前已指出的,这一部分所研究的骨骼可能有一些代表本属中之另一种。但是就現在情况来判断,并且和以前描述的山西山西鳄加以比較,似乎只代表一单一的种較为合适。两种大小都差不多,两种也都有大一些和小一些的个体。

在以上描述的过程中,我們曾交代的相当清楚,那就是把各部分骨骼和山西山西鳄相当的部分来比,两者相差很多。这主要表現在,这一种的头骨显然只有一个眼前孔,泪骨和方骨的形状特别,脊椎骨特别是背脊椎具有直稜,肱骨近端弯折,恥骨和坐骨为棒状,股骨較弯曲,和具有甲板等。另外,其他的骨骼虽不如以上的特别,但也有一些独具的性质。如肩胛骨、烏喙骨和足骨等。不特别清楚的为腸骨、腓骨和跟骨。无論如何,肯定的是除了两种山西鳄以外,在山西的假鳄类材料中,还有一新的假鳄类存在,毫无疑問。

这一种的脊椎骨,和非洲的 *Stagonosuchus nyassicus* 很有些象,特别是腹側的直稜和两側横突后的稜。此外,肱骨近端三角稜的急折,恥骨的样子,和坐骨的构造,也和这一种很相似。这一种沒有甲板保存,所以不能进一步和現在的种相比較。但在相反的方面,我們种的甲板和 Aetosauridae 一类的长方形甲板,大不相同。这就排斥了我們化石和这一科相近的任何可能性。所以我們的种只能和甲板側端为圓边的种,如 *Rauisuchus, Prestosuchus* 等属相比。至于小的一些假鳄类如 *Ornithosuchus* 和 *Euparkeria* 等,无論构造上或大小上都相差很远。所以我們应面临一新的假鳄类,看来和以上所列举的属俱不相同是十分显然的。我們建議把这一种假鳄类叫作汾河鳄,其代表的种为稜脊汾河鳄,新属新种。

**系統位置**: 按照各部骨骼和甲板的构造,我們这一新属距 Aetosauridae 为远,距 Rauisuchidae 为近。两者都归超科 Chirotheriodea(許耐等)。Stagonolepoidea(孔,1961)超科照孔的分类包括 Stagonolepidae, Aetosauridae, Desmatosuchidae 和 Rauisuchidae 四科。

最近瓦尔克(1961)研究了英国艾尔金(Elgin)地区的假鳄类,他把过去归于 Stagonolepidae 和 Aetosauridae 两科的属,重新加以划分: Aetosauridae 科

包括: *Aetosaurus, Stagonolepis, Typothorax, Desmatosuchus, Acompsosaurus* 和 *Stegomus*。

Erpetosuchidae 科

包括: *Erpetosuchus, Dyoplax,* 和 *Stegonosuchus*。

由于現在的研究,我們觉得許耐的 Rauisuchidae 一科,必須排除以上两科中的各属,而瓦尔克所建議把其他三科合并为一科叫作 Aetosauridae 看来是十分合理的。这末一来,除非我們的新种代表另一新科,把它归于 Rauisuchidae 一科,是沒有其他选择的。我們的新种的皮甲十分特殊,短而宽,內側有一孔,皺紋和痘痕状結构不显著,另一新科的可能性难以完全排除。

不幸的是我們对 Rauisuchidae 这一科的各属,特别是 *Rauisuchus* 这一属,所知很少,难以作进一步的比較,而且我們的标本,保存也不太好,主要的甲板和骨骼,大多零散发見。所以目前满足于以此种归于許耐的 Rauisuchidae 这一科。

**古生态方面的解說**: 稜脊汾河鳄是一个很大的动物。就一些大的脊椎骨和四肢骨来判断,它比大的山西山西鳄,不相上下,甚至更大一些。这个动物只比非洲的 *Stagonosuchus nyassicus* 稍小一些。比起山西山西鳄来,它在56173地点,是比較少的。就其笨大的四肢骨来看,也应当是习于池沼生活的一种动物。

汾河鳄的牙齿事实上等于完全不知道。尽管一前上顎骨上有一頗似有鋸齿状痕迹,可能还是和山西鳄相距很远。有可能接近于 Aetosauridae 一科各属的牙齿,也就是肯定不那末象山西鳄那样肉食性的。看来汾河鳄和所有肯氏兽各属一样,是这一动物羣中被当作猎取对象的。

这一新种的甲板,所知不多,但至少一大部分和脊椎骨以及其他头后骨骼的連属关系,似乎是沒有任何疑問的。虽然沒有多少直接的証明,但有許多可以間接証明此种关系的。象以上所指出的,这一种的甲板和

Aetosauridae 的在构造上很不一样。好象我們这一种的甲板并不十分发育，至少并不照 Stagonolepis 等那样全身为甲板所包褒。甲板的构造好象表示，尽管他的地质年代較老，但都相当特殊化。这个結論，也和脊椎骨和其他一些四肢骨的构造相符合。看来汾河鳄代表一假鳄类中較特殊的分枝。

尽管如此，必须指出，本属具有稜的脊椎骨，弯曲的股骨，和甲板彼此复迭的情况等性质，和一些副鳄类不无相似之处。虽然最原始的副鳄（*Mesorhinus*）已見于早三迭世，而其鼻孔已向后移，也好象不能排斥汾河鳄和副鳄可能有一些关系。至少在假鳄类中，我們这一属在比較上是和副鳄最接近的。前顎骨和下顎骨的一些性质也支持这个假定。

**病态現象：**在以前曾重复地指出过，这一类骨骼中有許多是病态的。特别清楚的为許多脊椎骨。大約有近于三分之一的脊椎骨不正常，或多或少异乎寻常的发育。一般說，有一边（經常为右边）或多或少有些肿大而椎体突和以后的稜，有些不清楚，甚或消失。在少数情况下，两边不对称。图 44 B 右侧几乎消失，而左侧的椎体突，病态发育。图 44 E 两边的椎体突有些錯移，非常的不对称。因为这个标本，保存很好，无任何破裂迹象，所以絕非是变形所能解释。即就是当作正型标本的图 44A′，横突和椎体突，也是两边不很一样。右边的可能是正常发育。特别大的脊椎骨（图 44，K、L），两边也有些反常。在图 44K，侧稜以上和以下的凹入部十分深，两边也不对称，其两边的椎体突也有錯位。不幸的是虽然許多变态脊椎骨无疑属于一个个体，但不能排列一可靠的、表明脊椎存在情况的病态脊椎的顺序。

至于四肢骨，变态的标本也不少。图 45 F 的烏喙骨具有奇怪的凹面，而在另一边，却有两个孔，可以当作是不正常的发育。同一图 I 的肱骨，或者受了挤压而变形，或者是病态的象征，或者两者均有影响。形状最特殊的腸骨（图 46，D）也是如此。虽然不如以上的显著，但大多数的股骨（图 47，A—C），好象都有些病态現象，表现在两端的形状很不相同上。在一些沒有繪图的相同一骨骼上，这个情况，也是經常可看到的。此等情况，在山西山西鳄，也有同样情形（图 31），但不如这一种的显著。图 47 A 可能为一正常发育的标本，或者大体如此。在脛骨、腓骨和足骨的骨骼上，象这样病态的发育，不如以上的清楚，但也有所表现，如图 48D（脛骨）；图 48G（距骨）；图 49A 和 C（Mt. I）；图 49 D.（Mt. III）等，看来也很难当作是发育正常的一个骨骼。

根据以上的記录，我們可得出一个結論，就是汾河鳄的許多骨骼是病态的。为什么如此，是何原因，不容易得到解答。或者可能由于流行一种什么病造成这样现象，或者由于受了伤而后复原引起这些特殊现象。虽然說汾河鳄是具有甲板保护的，但稜脊汾河鳄和山西山西鳄生活在一起，看来不是那么舒适的。

**关于幼年个体：**如同山西山西鳄一样，汾河鳄也有不少未成长甚或幼年的个体，經常发现。脊椎骨比較少，四肢骨比較多。有时候可以使人怀疑，到底它們应当归那一种。有些破碎的标本，連确定为那一个骨骼也有困难。这个事实表示当岩层造成的时候，至少在 56173 地点，是在比較安靜的状况下造成的，这和認为有急流造成之說，恰恰相反。

由于骨化堆积的丰富，再加上至今已知各种混合一起的情况，強烈表示，在較近的距离內，堆积形成于一环境变化特殊的情况下。甚至可能就在原来生存不远的地方。

**汾河鳄的再造：**因为汾河鳄的头骨部分保存太少，四肢部分非常零散，无法得到可靠的彼此比例。因此不能象山西山西鳄那样，搞一个再造复原图。但是我們动物的一般形象，应当和許耐为同科的 Prestosuchus 所复原的形象，有些近似之处。

## 超科：鳥鱷类（Ornithosuchoidea Hoffst. 1955）

## 科：新巴氏鱷科（Euparkeridae v. Huene, 1920）

## 属：王氏鳄（*Wangisuchus*, gen. nov.）新属

以正型种择义王氏鳄的特性，作为本属的代表特性。

## 择义王氏鳄（*Wangisuchus tzeyii* sp. nov.）新种

**材料**: 两左和两右上颚骨,均来自武乡楼则峪西什凹(56173 地点)(V.2701—V.2704),以 V. 2701 作为正型,其他(V. 2502—V. 2504)作为副型。

以下的一些标本,也来自 56173,也归入此一新种。可能有两泪骨,一方骨。14 頸脊椎,至少四十三背脊椎,其中有一部分还自然接連。在图 54 所示的几个荐骨前脊椎和尾前部脊椎也暂归入于此种。若干荐骨脊椎,其中有三个归于一个个体,和一些第一、第二荐骨肋骨。大約有五十三个尾脊椎。一个还和烏喙骨相連接的肩胛骨近端(大約为一未成年个体)和五个单一的烏喙骨。两肱骨的近端和一个远端,两个橈骨,一个破碎的腸骨,四恥骨,二坐骨,三个近于完整的股骨,另有七个破碎的股骨。十二个脛骨的两端,許多腓骨碎块。一距骨,一跟骨和一些足(?前足)骨,有一些比較小的而形状不同于前所記述的归于稜脊汾河鳄的甲板,也暂归于此种。另外还有若干不能进一步鉴定的小骨骼,也非常有可能归于这一个新种。

照作者的研究結果看来,以上所列举的标本,在构造上和大小上当作一个种十分合适。但不能完全排斥这末一可能性,卽有一些可能归于其他种或甚至还为未确定出来的种。

以下为 56173 地点以外,由其他地点采集可归于这一种的材料:

1.武乡楼則峪狼窝沟,見赶沟(56157)。部分还接連的背脊椎,破碎的四肢骨,和一些可能为甲板的碎片。可能属于一个体。V.2705。

2.武乡石壁北盘頂(5523)。两个破碎的牙齿,破碎的四肢骨(一尺骨接近完整)和一部分右手骨还自然地連接。可能为一个体。V.2706。

3.武乡楼則峪牛口峪(5535)一完全的牙齿和二尺骨。V.2707。

4.小宋沟,詳細地点不明。一脊椎骨。V.2708。

5.龙土沟,地点不明。一脛骨。V.2709。

同在山西找見的其他假鳄类比較起来,这一种是为数不多的。在 56173 地点,至多只有五个个体。它的地理分布,也比較有限,見赶沟的标本,代表本种存在甚为可靠。北盘頂也可能无大問题,其他就不那末十分可靠。至于武乡榆社区域以外的地方,还沒发見过这一种。

**层位和产地**: 下三迭統最上部,或中三迭統下部,与山西山西鳄,稜脊汾河鳄同层。地点見以上所列。

**特征**: 上颚骨长而低,后部尖銳。前端和前颚骨接触处較圓。淸楚地沒有第二眼前孔。眼前孔的边緣象新巴氏鳄(*Euparkeria*)那样有一比較淸楚的台架。牙齿为半槽齿式的,一如山西山西鳄。由上颚骨上保存不好的牙齿和自 5523 及 5535 两地保存的牙齿来判断,牙齿左右扁平或为枪状或稍向后弯曲。也有微弱的鋸齿状构造。脊椎骨頸脊椎伸长。背脊椎也較长,背棘末端粗大。可能有三荐骨脊椎。四肢骨比較細小。烏喙骨孔开口,恥骨短,坐骨有长的柄。股骨作"S"状弯曲。跟骨有迳状突出。手骨与足骨不那末伸长。

## 描　　述

### 头　骨　部　分

**上颚骨**: 图 51 A—D,一共有两左两右上颚骨,成长而最完全的为 V. 2701,这是一个左側的上颚骨,被选作正型。另一个右側的比正型小一些(图 51,D),另外两个一左一右的上颚骨,比起正型标本来,不那末成年.大小也不同。因此,这四个两左两右的上颚骨,看来并不代表两个个体,而是代表四个个体。

正型上颚骨最为完全(图 51, A),除了前端的向上突起有些损破外,实际上是完全的。总长 111 毫米。前高 35 毫米,中部高 21 毫米,通过前端在向上突起根部以后的厚度为 11 毫米。从前端起,向后只輕微变窄,直到末端前 24 毫米的地方,才突变窄,然后形成一尖状的末端。介于上突起后和尖端根部之間,乃眼前孔的下边,而其他部分,包括尖端在內,为和顴骨接連的地方。沿边緣的"台架",虽然不如其他标本的淸楚(这或由于較成年之故),但也可以淸楚地辨認出来。上颚骨的前端,为鈍角状的圓边。其和别的假鳄类分别的地方,在于下部有較直竖的边,显然为和前颚骨連接处,而上部为一較陡坡状边,为和鼻骨接触的地方。是

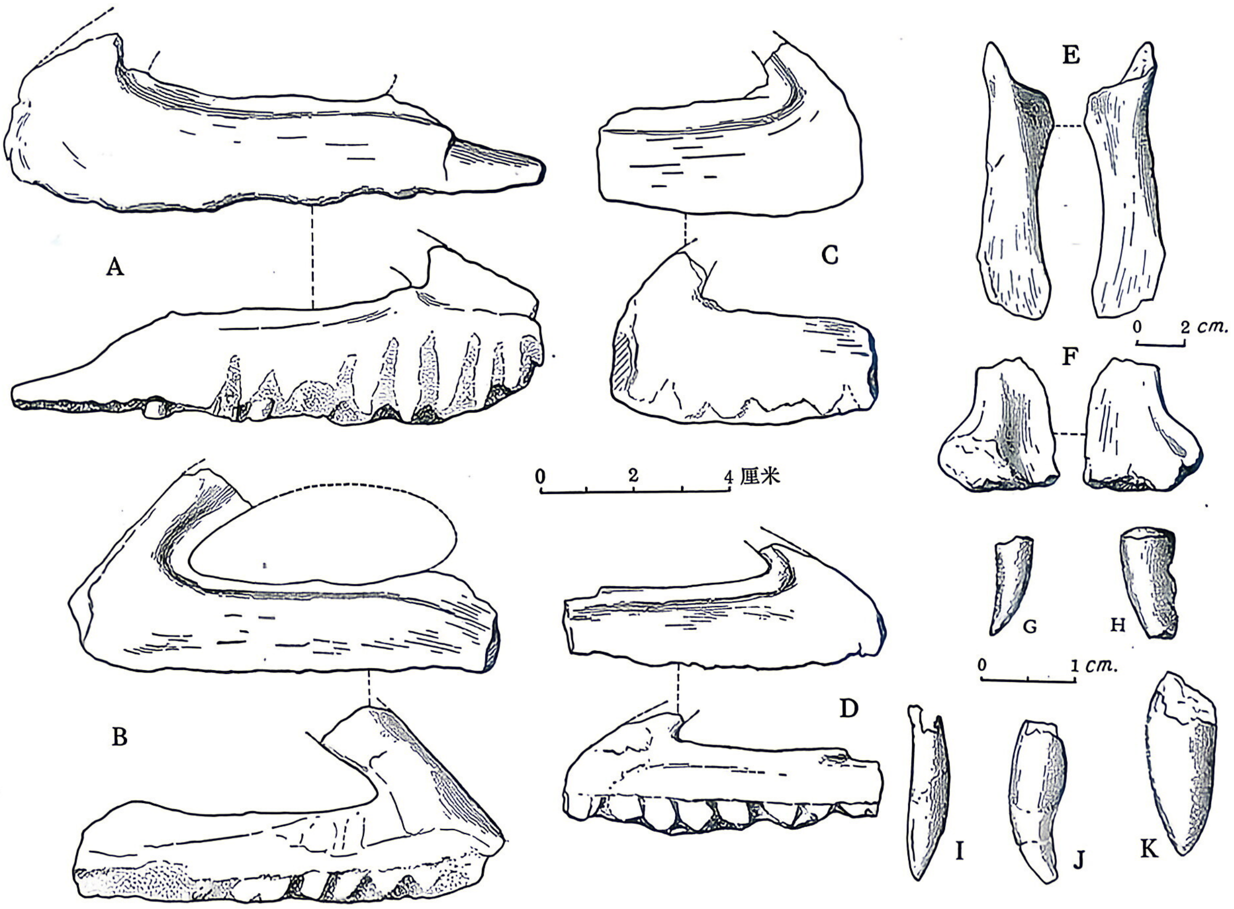


图 51 择义王氏鳄,新属新种

A. 左上颚骨(正型); B. 左上颚骨; C—D. 右上颚骨,内外观,原大三分之二; E.? 泪骨,原大三分之一; F. 方骨末端双面观,原大三分之二; G—K. 零散牙齿,原大三分之二。均详见正文。

Fig. 51 *Wangisuchus tzeyii* gen. et sp. nov. A. left maxilla (the type); B. left maxilla; C—D. right maxilla. in labial and lingual views. 2/3 nat. size; E. probably lacrymal. 1/3 nat. size; F. distal end of quadrate in two views. 2/3 nat. size; G. tooth from 5535; H and I. teeth from 5523; J and K. isolated teeth. All 2/3 nat. size.

不是这一部分也造成鼻孔的一部分,不很明确,可能同其他大多数假鳄类一样,不造成鼻孔的边緣的部分。上颚骨的內面,只輕微的凸出,而外面则相当的平。正型标本的牙齿保存欠佳。但是由于标本很完全,所以可相当准确地判定上颚牙齿的总数为十三个,或至多十四个。虽然保存不好,而牙床边緣在其他标本,保存較佳,但其曲折状的牙骨板构造,也或多或少可以辨認出来。从后端算起,第四第六和第七牙的根部,保存了一部分。这些牙表示同以下要描述的单个牙一样,有左右挤扁的现象。这些牙为半槽齿式和同一大小的牙齿,所以和加斯馬吐龙的牙齿有很大的区别。

右上颚骨(V. 2703)(图 51,C),很难同上一标本配成一对,作为同一个体,因为小的多。只有从前端算起 55 毫米长,一部分保存。这个标本受了点变形,其外边平的一面,变为稍为凸出,上突起根部也保存。眼前孔下边的"台架"也特别清楚。

另外一个左上颚骨(V. 2702)(图 51, B)也同正型标本一样,保存很好,只是最后端未保存。上突起保存較好,只有末端损坏。在所有能观察到的性质上和正型标本完全一样,只稍小一些。上突起后的高度为 22 毫米,在后部距破裂处不远的高度为 21 毫米,还比前端稍高一些,这应代表眼前孔的下后角处,沿边緣的"台架"十分清楚。沿牙齿緣有十个介于折曲状的三角骨板間的牙窝。

第四个标本为另一右上顎(V. 2704)(图 51, D),这个标本,当为一年輕个体。它的上突起只作殘余状

的发育，后端未保存。一共有七个牙孔。只有从前端算起第六个孔有牙的根部保存，也表示横的扁平形状。上突起后高20毫米，近破裂处高12毫米。

虽然以上描述的四个上顎骨大小不一样，但在主要性质上完全相同。如牙齿的构造，眼前孔边緣的形状和下緣的直的外形等。毫无疑問，它們代表一个种的上顎。

**泪骨**：图51 E，作为这一种的泪骨，并不是毫无疑問的。就大小說，似乎很合适。总长为113毫米，看来显然为一左側的泪骨。其他假鰐类泪骨向前很伸出的上部的非常发育的突起，在这个标本上缺失。故怀疑可能为后眶骨，但其近端的結构迴然不同。在沒有新的較好的标本以前，这个問題在目前只好不决定它。另外还有一个較小标本，其近端破損，也代表同一个骨骼。

**方骨**：图51 F，代表一右方骨的末端的关节部分。宽25毫米，可能归此种。

**牙齿**：一共有五个零星发見的牙齿(图51，G—K)。一个来自5535地点(51，G)，两个来自5523地点(图51，H—I)，其余来自56173地点(图51，J—K)。这些牙齿都認为可归于此种。最后一牙(图51，K)，可能对这一种来說稍大一些，其他牙均与上述的上顎骨很配合。所有牙齿均左右扁平。在較小牙齿边緣，鋸齿状不清楚。而在較大的牙齿上(J和K)，鋸齿状构造十分清楚。同石片沟(5537)最末加斯馬吐龙的牙齿相比，尖端不很向后弯曲。除此以外，也有些外形上相似之处。无法判断各个牙齿在牙列上的具体位置，甚至为上牙或下牙也都很难說。

## 脊　椎　骨

因为多数的脊椎骨都是零散地找見的，所以不能确切肯定每一脊椎骨在脊柱上的眞实位置。因为这些脊椎骨，比上述的山西山西鰐和稜脊汾河鰐小的多，而比黑峪口山西鰐也較小，似乎他們之归于这一种，沒有多大疑問。除了少数几个例外以外，多数在大小上都很一致。此外，也都具有一定的若干共同性质。因此，虽然不能完全排除有少数几个脊椎可能有些問題以外，其他大多数脊椎骨都可无疑的归于这一新种。

**頸脊椎**：一共有十二个頸脊椎，其中有五个見图52 A—E。所有頸脊椎均或多或少为弱的双凹状，而較为延伸。它們或者比背脊椎为长，或至少大約相等。有些脊椎，其椎体突保存完好，位于前端很低的地方。椎体的两側，多少有些凹入。腹側或者具有浅沟，或者有一显著的稜，前者属頸的較前部，而后者属于較后部。在多数情况下，神經弧保存不好，如附图所示。

如果以上所作的鉴定不錯的話，这些頸脊椎有些同加斯馬吐龙的頸脊椎相似，較为伸长，但沒有間椎体，一如汾河鰐那样。

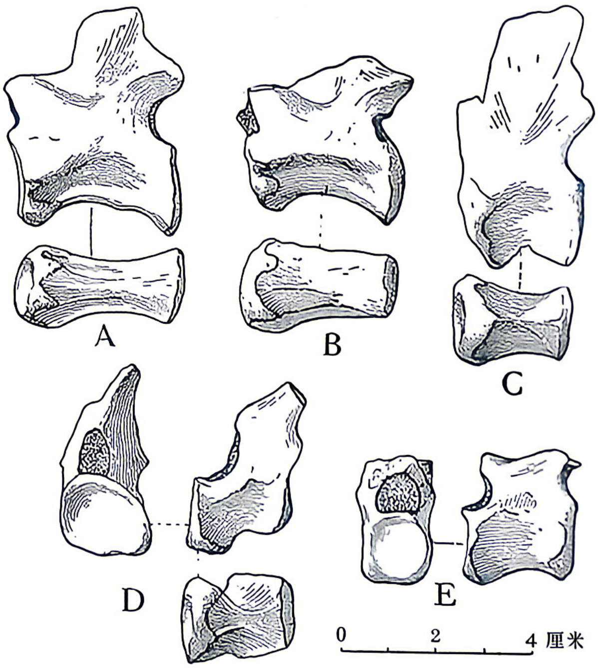


图52　择义王氏鰐，新属新种
A—E. 頸脊椎側背和前視，詳見正文。均原大三分之二。
Fig. 52 *Wangisuchus tzeyii* gen. et sp. nov. A—E. neck vertebrae in side, ventral and anterior views. For details see text. 2/3 nat. size.

**背脊椎**：比較上背脊椎保存很为丰富(图53—54)，但是眞正的背前部脊椎还是不多。在脊椎上的确切位置不易肯定。这些背前部脊柱，大約和頸椎同长，或比之稍短，但比背后部脊椎却长一些。它們的椎体比較粗壮一些，中部不太收縮，腹側也沒有沟或稜状发育。有少数脊椎，其神經弧还保存。在图53 A和B，椎体突的位置相当之低，紧在椎体的前側边当很靠前，归于离肩胛带很近的地方；而图C—F，椎体突向上推移，且有些和横突混連起来，当属

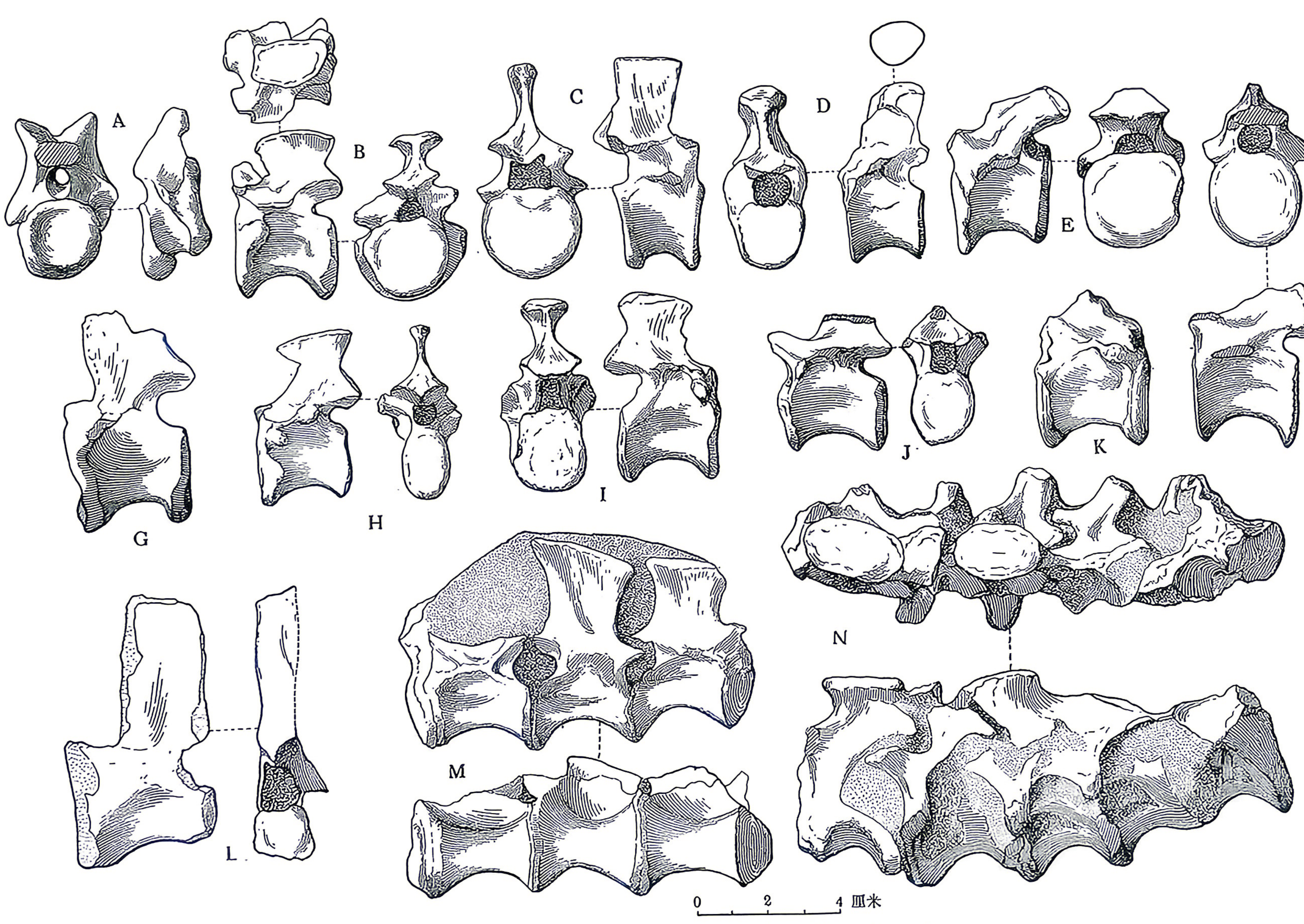


图 53　择义王氏鳄，新属新种

A—N. 背脊椎各面观，詳見正文。均原大三分之二。

Fig. 53 *Wangisuchus tzeyii* gen. et sp. nov. A—N. dorsal vertebrae in different views. For details see text. 2/3 nat. size.

于脊椎的中部。背棘末端多少有些加厚。

背后部脊椎有許多单个的标本保存，但最好的为一个由三个脊椎，另一个由五个脊椎还天然地相連接的两串脊椎，这見图53M和N。它們的椎心相当延长，中部比較收縮。椎体突一般地再看不見或和短而向下垂的横突接連在一起。背棘很低，其末端如同背前部脊椎一样，发育更好。在56157地点（V.2705）也有几个連在一起的背后部脊椎，除了背棘稍长以外，其他性质大致和这里所描述的背后部脊椎相同，毫无疑問归于同种。

另外，有几个比較反常的脊椎骨見图54 A—E，它們比上述的腰脊椎稍大一些。此外，还有椎体的两端或大小大不相同，或更为双凹一些；腹面有的有沟，有的有稜。这几个脊椎可能有些病态。暫以之归于此种。图54F 一脊椎比較粗大一些，但背棘末端，好象不怎么加厚。横突好象破損。这一脊椎可能为一尾前部脊椎，也可能为一腰部脊椎。

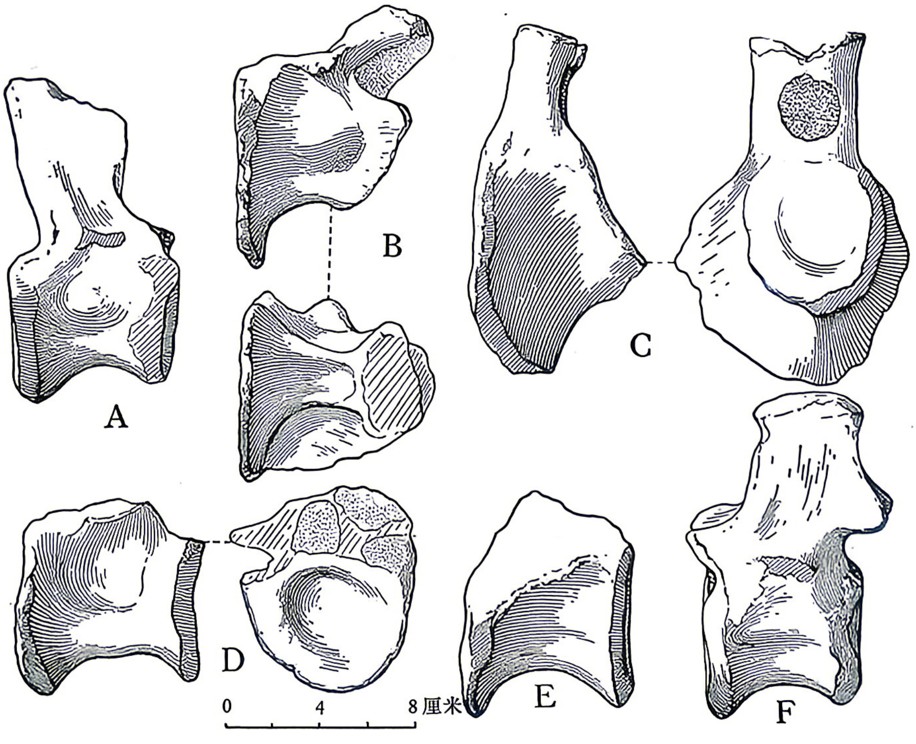


图54 择义王氏鳄，新属新种
續图53，詳見正文。原大三分之二。

Fig. 54 *Wangisuchus tzeyii* gen et sp. nov. Continuation of fig. 53. For details see text. 2/3 nat. size.

除了图54D以外，其他所有背脊椎，都是双平式的。

象在表14所表示的，所有脊椎的大小差別不大，互相接近。有些未繪图的小脊椎骨，总的說来，差別不算大。

**荐骨脊椎和荐骨肋骨**：荐骨脊椎象图55A和B所示的，极可能由三个脊椎骨組成。这两个标本，可以比較合适的連在一起，而把B当作Sa.II和Sa.III，而把A当作Sa.I。但是两个的顏色不同，A为灰色，B为淡黄色，因此乃属于两个个体。在B标本，左边一个脊椎骨椎心不如右边二个那末收縮。两个脊椎骨的背棘末端全保存，图的右边一个(Sa.III)比前一个(Sa.II)只微有加厚。扩展的横突，两个愈合在一起，后部稍有損坏。两个脊椎本身，也互为愈合，好象为一年老个体。图55A极为可能代表第一个荐骨脊椎(看来有两个可能，一为B为Sa.I–II，以背棘較粗者为前端，而A为Sa.III；另一可能为反过来以A为Sa.I而B为Sa.II和Sa.III，而末一个背棘为粗一些的，看来不太合适。我們之所以采取后一个可能是因为粗的横突部分放在

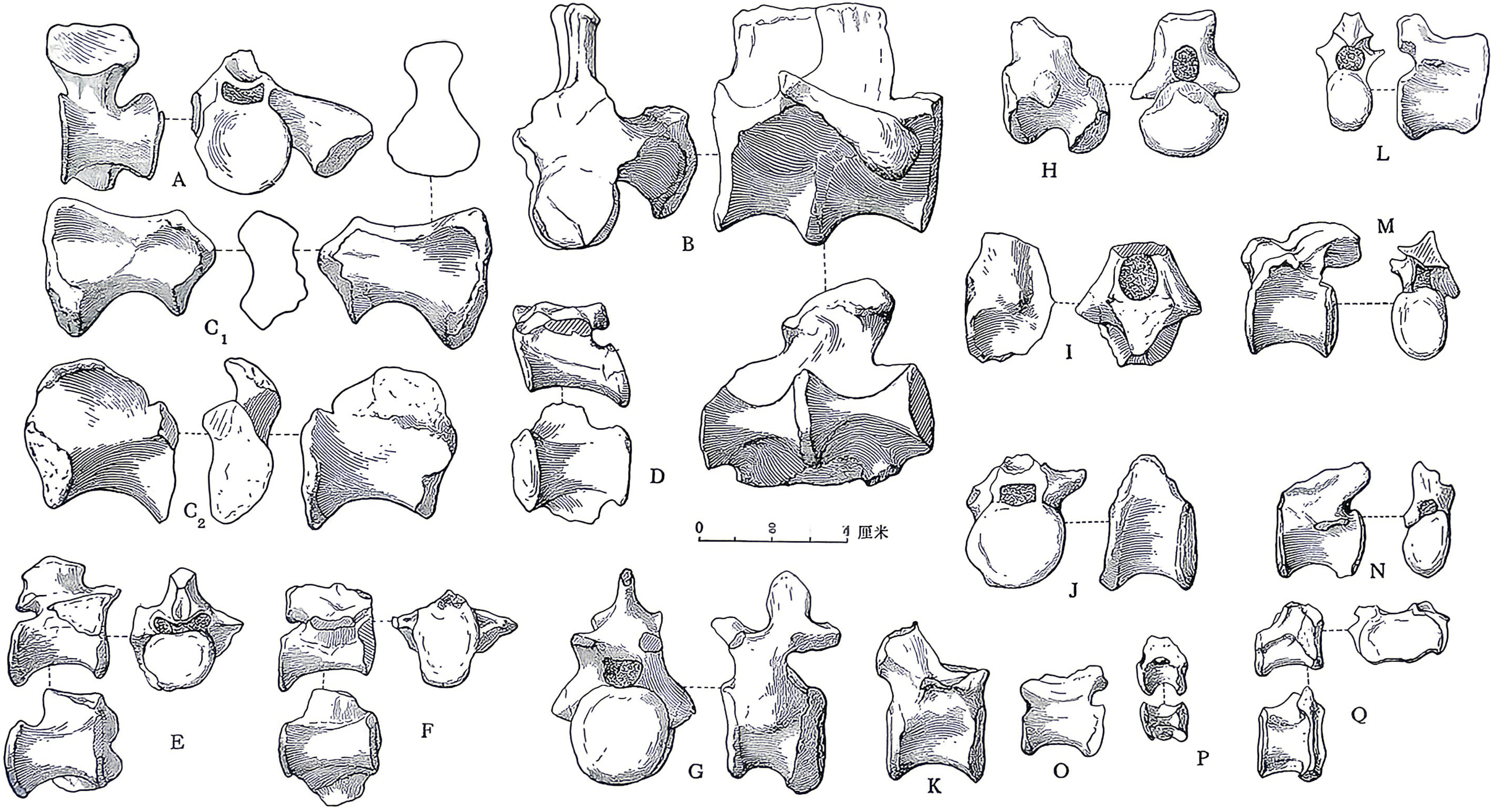


图 55　择义王氏鳄，新属新种

A. sa. I; B. sa. II—III; $C_1$. 第一荐骨肋骨; $C_2$. 可能第二荐骨肋骨; D—F. 第三荐骨脊椎; G—O. 尾脊椎，詳見正文; P. 5523 脊椎; Q. 可疑脊椎，詳見正文。均原大三分之二。

Fig. 55 *Wangisuchus tzeyii* gen et sp. nov. A. sacral vertebrae I in ventral and anterior views; B. sacral vertebrae II and III in posterior, right side and ventral views; $C_1$. right sacral rib I with outline of both ends; $C_2$. probably sacral rib II in three views; D—F. three sacral vertebrae in different views; G—O. anterior to posterior caudal vertebrae in different views. For details see text; P. a vertebra from locality 5523 of doubtful belonging, see text; Q. a vertebra unidentified, see text. All 2/3 nat. size.

Sa.II 和 Sa.III 間比較适合于以下要描述的荐骨肋骨)。其椎心比較不太收縮，和B左側一个相似，这使得 Sa.II 椎心最为收縮，支持上边所作的排列。右側的横突末端特別加厚，和下边的右第一荐骨(55, $C_1$)肋骨巧相接合(尽管不是一个体)。

这个荐骨肋骨，比起山西山西鰐的第一荐骨肋骨来有些相似，但特別小，也窄一些，比起同一种的第二荐骨肋骨来(图55, $C_2$)較为作长方形輪廓。另一荐骨肋骨(图55, $C_2$)可能为第二荐骨脊椎的荐骨肋骨，因为其近端和图55B的第二脊椎很适合。这个标本形状很特殊，作为第二荐骨肋骨来講，好象也大一些。

另外有几个保存比較好的荐骨脊椎，見图55D—F。D和E为 Sa. I，而F为 Sa. III。

尽管荐骨脊椎和荐骨肋骨有不少好的标本，但是关于这部分脊椎的构造，还有一些地方不特別明了。

**尾脊椎**：一共有九个尾部脊椎，見于图55G—O。G—I为尾前部，J为前中部，其余为尾中后部。如上所述，图53L和图54E、F，也有可能为尾脊椎。图55G保存最全，其腹側具有寬沟与腹棘連接的面，也表示的非常清楚。横突作尖圓椎状而背棘很短，沒有末端粗的痕迹。图55H和55I两脊椎的构造和55G很近似，但腹側沒有沟，相反横地扁平，成一稜状。图55J的椎心几乎沒有收縮，可能比以上几个脊椎更靠后一些。它的横突縮小，稍向上伸。其他脊椎都比較长一些，为标准的尾較后部的脊椎(图55, K—O)。

在图55P所示的一脊椎可能为一幼年个体的。它来自5523地点和其他归于这一种的四肢骨在一起发見。腹側有沟。它在脊柱的位置不清楚，可能为一尾脊椎。

另外一个来自56173地点的(图55, Q)絕不是这一种的脊椎。它的两端很特別，前端比后端大，也特別寬而低。所以附图于此，只是表示在56173地点，似乎还有未知的动物存在。

关于脊椎和四肢骨等的尺度見表14(頁175)。

## 肩 带 和 前 肢

**肩胛骨和烏喙骨**：沒有无疑的单个肩胛骨。但有一右肩胛骨、烏喙骨合在一起的标本(图56, A)。肩胛骨的近端保存。因为保存很差，在构造上无多可講。沿烏喙骨边的寬为43毫米。和烏喙骨接触处，坚固地愈合在一起。肩臼面保存很完整。但标本的內側几乎全然隐蔽，和烏喙骨接触的綫，可以隐約地辨認出来。

与之相連的烏喙骨，为圓角四边形的輪廓而且較薄。烏喙孔靠近肩胛骨边緣，前后长为49毫米，和肩胛骨边相垂直的寬为34毫米。初步观察，这个肩胛骨和烏喙骨相連的标本，好象代表一年輕个体，尽管两骨愈合而为一。

另外还有两个右側、三个左側的单一的烏喙骨归于此种，边緣上均多少有些损坏。一个大小中等的烏喙骨示于图56B，也較为完整。这一烏喙骨和上述的不同地方在于开口的烏喙孔較大。在五个烏喙骨中，只有一个烏喙孔是封閉的。这个骨的一般形状和 *Stagonolepis robersoni* 的有些相似，可是比之小一倍以上。

**鎖骨(?)**：好象有两个骨可以归于鎖骨(图56, C—D)。一个其近端受損，但另一端保存相当好。另外一个近端較全，而远端缺失。对于鎖骨来說，这骨几乎太直，只有近端部分，作向內側弯曲状。近端寬39毫米，远端寬12毫米。对于这一种来說，这个鎖骨可能稍大一些，其归于黑峪口山西鰐的可能性不能完全排除。两个骨都代表幼年个体，所以也增加了鉴定上的困难。

**肱骨**：归于这一种的肱骨有一左側的近端，一右側的近端和一右側的远端。这些标本的大小和以上描述的肩胛骨烏喙骨很适合(图56, E—G)。左边的近端寬为67毫米。下端破失地方的寬为13毫米。关节处很发育。三角稜不十分显著。近端扩展部分和本文描述的其他种一样，相当的寬。向末端方向收縮的程度非常急驟。另外一右肱骨近端的性质除了少一些以外，和前一个标本相同。近端寬56毫米，另外一右肱骨下部部分在远端已很加寬。近远端处寬为56毫米。骨干破裂处寬为14毫米。好象我們这一种的肱骨也是如山西鰐和汾河鰐一样为两端加寬的，而不象 *Hesperosuchus* 的肱骨那样細瘦。骨干中部十分收縮。虽然我們沒有一点証据証明那右肱骨上部和右肱骨下部两标本可归于一个个体，但大約可用以估計出肱骨的长度，即大約为164毫米。比以下归于这一种的股骨之稍长，比另外一个稍短。很清楚，这个动物不象后期的鳥鰐类一样为两足行走，而是四足行走的。

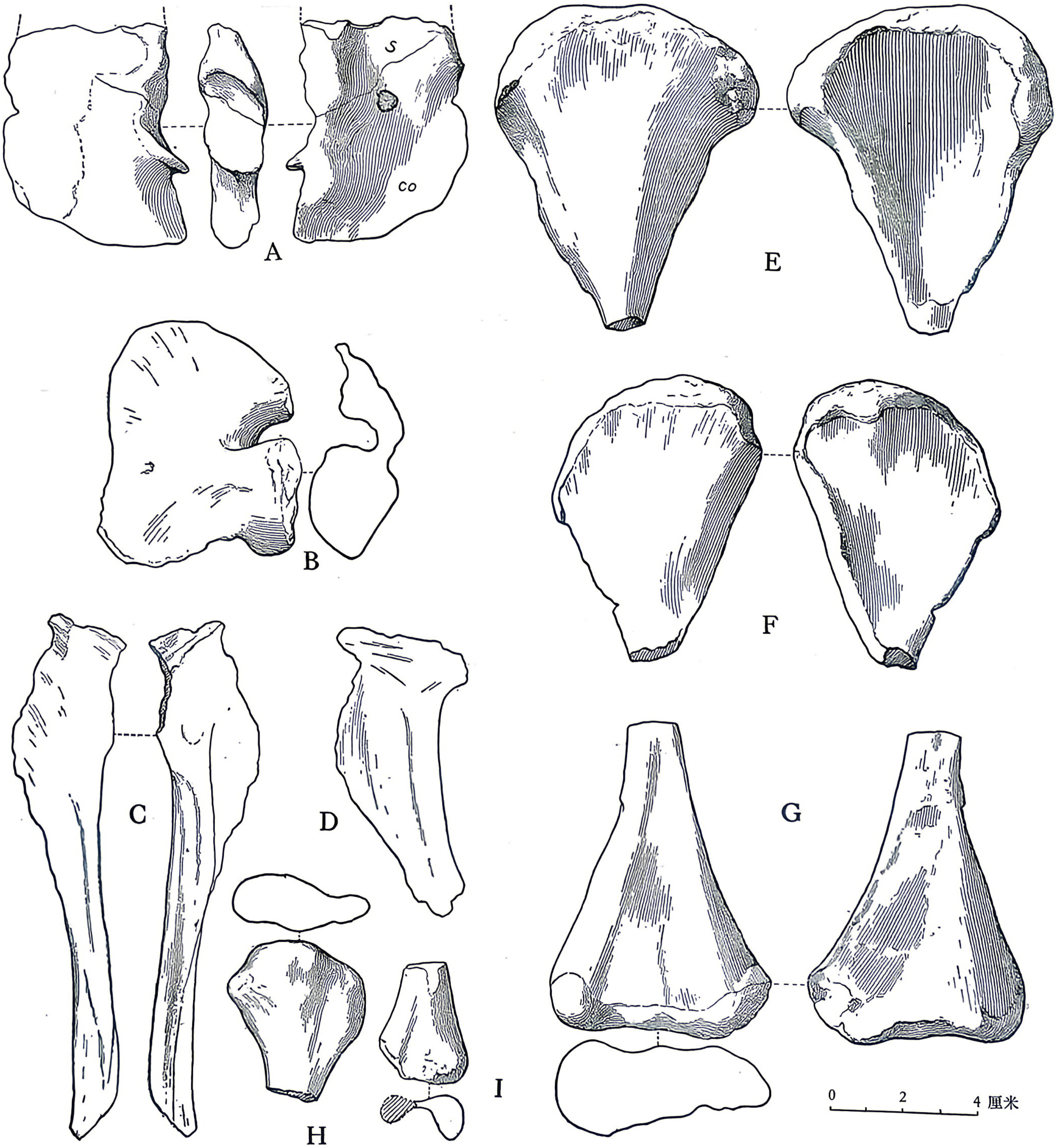


图 56 择 义 王 氏 鳄，新 属 新 种

A. 左肩胛骨与烏喙骨； B. 右烏喙骨； C—D. 二間鎖骨，詳見正文； E. 左； F. 右肱骨； G. 右肱骨末端； H—I. 可能归于此种的幼年肱骨近端和远端，詳見正文。均原大三分之二。

Fig. 56 *Wangisuchus tzeyii* gen. et sp. nov. A. left scapula and coracoid co-osified in three views; B. right coracoid in external views with the outline of the scapula border; C and D. probably two intercavicle. For details see text; E. left; F. right of the proximal part of humerus, in two views; G. distal part of a left humerus in two views with outline of the distal end; H and I. proximal part and distal part of a right humerus may be the young individual of the same species or of some other form. 2/3 nat. size.

另外两个左肱骨的近端和远端(图 56, H—I)非常可疑。它們可能归于一个个体,但中部缺失。两标本比上述的肱骨小的多。虽然很小,而其近端的关节处却相对地粗壮。它們可能属于这一种的幼年标本,也可能代表一尚未知的一种动物。

**尺骨**: 这一骨在我們材料中的存在还是非常不明确的。有一个近端一个远端的尺骨，比黑峪口山西鳄为小。但因保存不佳,沒有什么可以特别加以叙述的。

**橈骨**: 两个来自 56173 地点(图 57, A、B)的橈骨在大小上不很相同。B較粗大,而A較細弱一些。后者可能代表一較年輕个体。两橈骨似均为右側。图 57C来自 5523 地点，也似为一橈骨。这个标本比图 57 A还細一些,但其长度却大約相等。也为一幼年个体的橈骨。 长度: A, 102 毫米; B, 97 毫米; C, 102 毫

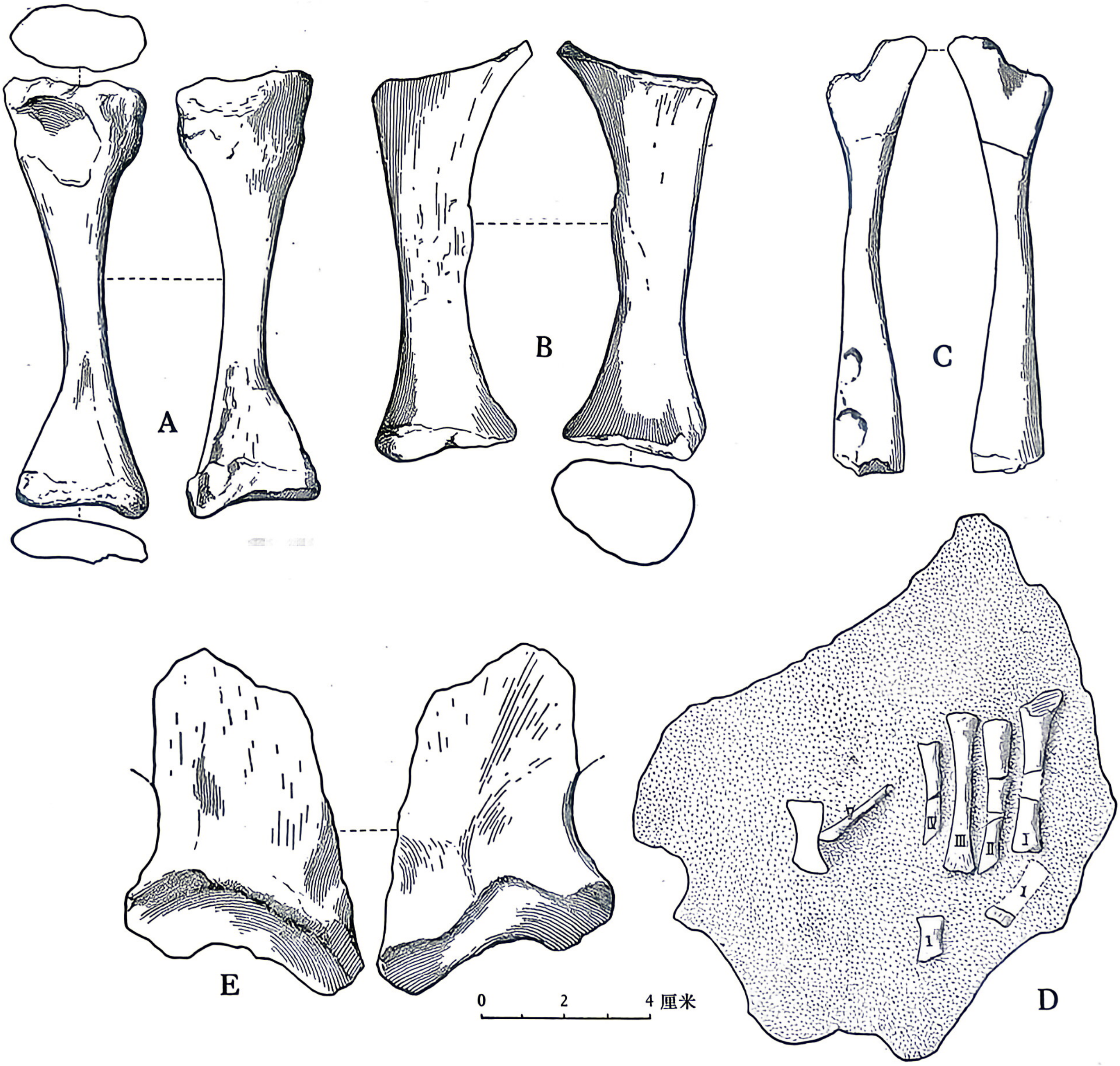


图 57 择义王氏鳄,新属新种

A—B. 橈骨; C. 5523 地点橈骨; D. 右手骨(5523); E. 右腸骨。詳見正文。均原大三分之二。

Fig. 57 *Wangisuchus tzeyii.* gen. et sp. nov. A. radius of a young individual in two views with the outline of both ends; B. radius of a older individual (?pachysteous) in two views with the outline of the distal end (the proximal and being damaged); C. a radius of very young individual from 5523 in two views; D. a right hand from 5523 in dorsal view. probably a young individual; E. right ilium in external and inner views. All 2/3 nat. size.

米。近端宽：A，30毫米；B，35毫米；C，?23毫米。远端宽：A，29毫米；B，33毫米；C，?17毫米。

**手骨**：并无手跟骨保存。从5523地点，有一不完整，但是还大体上相連的右足骨(图57，D)。Mtc. I—V还相当自然地連接，只有Mtc. V向外錯移。Mtc. I的一部分，Mtc. IV的远端和Mtc. V的两端有些殘破。这些手掌骨都很細长。Mtc. I比較粗大一些，愈向外，手掌骨变得愈細长。Mtc. II和Mtc. III差不多同长。Mtc. V特别細小，两端只微有变宽。总的說来，手掌骨看来相当原始。近端Mtc. I—IV总宽33毫米。Mtc. I至Mtc. V的长度，依次为36，38，38，31和28毫米。Mtc. I的近端和远端的宽为11和9毫米。紧在Mtc. I之下，有一指骨，卽为Mtc. I的第一指骨。保存不佳，除远端外，只有印痕保存。长17毫米，远端宽8毫米。另外一指骨見于Mtc. IV以下，但极可能是归于Mtc. III的第一指骨。这一指骨也不很完全，长度約为15毫米。因为5523地点的其他骨骼，都是代表未成年个体，这个手骨也应当代表同一幼年个体。

## 腰带和后肢

**腸骨**：只有一破的右腸骨，自髋臼以上相当损殘，但隐約还可以認出向后突起根部向后伸出之状。髋臼并未穿透。其下边一部也缺失。对于以下要描述的股骨头来講，显得髋臼太大一些。髋臼以上之宽为51毫米，髋臼直径为56毫米。

**耻骨**：一共有两个左耻骨，一个右耻骨。耻骨的构造很为特殊。非常之短而宽，远端多少有些加厚（特别为綸图的这标本最厚)(图58，A)。和腸骨接連的面，相当的平。两个小的耻骨孔未开口。近端宽50毫米；极长59毫米；与坐骨連接面长35毫米，近端极厚为18毫米；远端极厚为?23毫米。另外两个未綸图的耻骨，稍小一些，也較薄一些。

**坐骨**：这一骨有一完整的左坐骨，两右边的近端部分(图59，A)。和短的耻骨相反，坐骨較长，作柄状。如果鉴定不錯，这一种的腰带骨和新巴氏鱷(*Euparkeria*)的腰带有些近似。但我們的坐骨有些細小，它的近端相当之宽。前緣稍有损坏，所以該骨实际上比图所表示的稍宽。和髋臼接觸面很厚，而耻骨边有些受損。全骨向末端逐漸变窄，只有距远端不远处，有一微弱的收縮。末端輪廓作三角状。坐骨的內側还为岩石所盖，为保护不受损計，未予除去。前全长139毫米，后全长115毫米，近端保存的宽63毫米，末端宽29毫米。另外两右坐骨約和这一个同大。髋臼和耻骨边間的肩状形很淸楚。耻骨边保存較好。虽然腰带骨的三个骨均保存，但主要因腸骨太破碎，很难作一可靠的复原。总的說来，如上所述，这一新种的腰带骨好象显示出和同一地质时代新巴氏鱷腰带骨的形象。

**股骨**：有五左一右及一些破碎的股骨，表示仅自56173这一个地点，就至少有五个个体(图58，B—D)。只有一个是十分完整的(图58，B)。图58C也很完全，但有些变形和扭曲。另外一个(图58，D)远端部分也稍有变形，而近端有些殘缺。其他标本，均多以远端部分为代表。从外側看，股骨作微弱的"S"状的弯曲。这个股骨和*Hesperosuchus*（Colbert，1952）的股骨很有些相象。这一新种的股骨比起这一属的股骨来稍长一些。中間部分細弱而薄，因之两端也显得較宽。第四椎体距近端很近。另外两股骨大体上重复以上描述的股骨的主要性质，只稍微有些細微的区别。两个骨的破裂部分表示骨壁相当之薄，这个现象也为其他破的股骨所証实。总长：图58 B，161毫米；58C，170毫米。近端宽：图58 B，33毫米；58 C，37毫米。远端宽：图58 B，29毫米；58 C，36毫米。中間的宽和长：图58B，9×17毫米；58C，10×16毫米；58 D，12×19毫米。

这里所描述的股骨好象比起上述的肱骨来，显得太小一点。它比起肱骨来差不多同长，或稍微长一些。但是所有在这里記述的骨骼的彼此連系似乎(除以上已指出的个别例外)很难設想，在这一动物羣中，还另有一种假鱷类存在。所以看来必须承認我們这一个动物乃是基本以四足行走的动物，而不是以后足行走的。

**脛骨**：属于此骨的有許多标本，但沒有一个是完全的。比較完全的，是一个近端部分和另一远端部分，見图59 B—D。那一个具有完全近端的为右側，而較完整的远端一标本为左側。保存比較好的标本也为右側。和股骨的細长形状比起来，脛骨是比較粗壮的。近端形状表示cnemial crest不很发育。比起山西山西

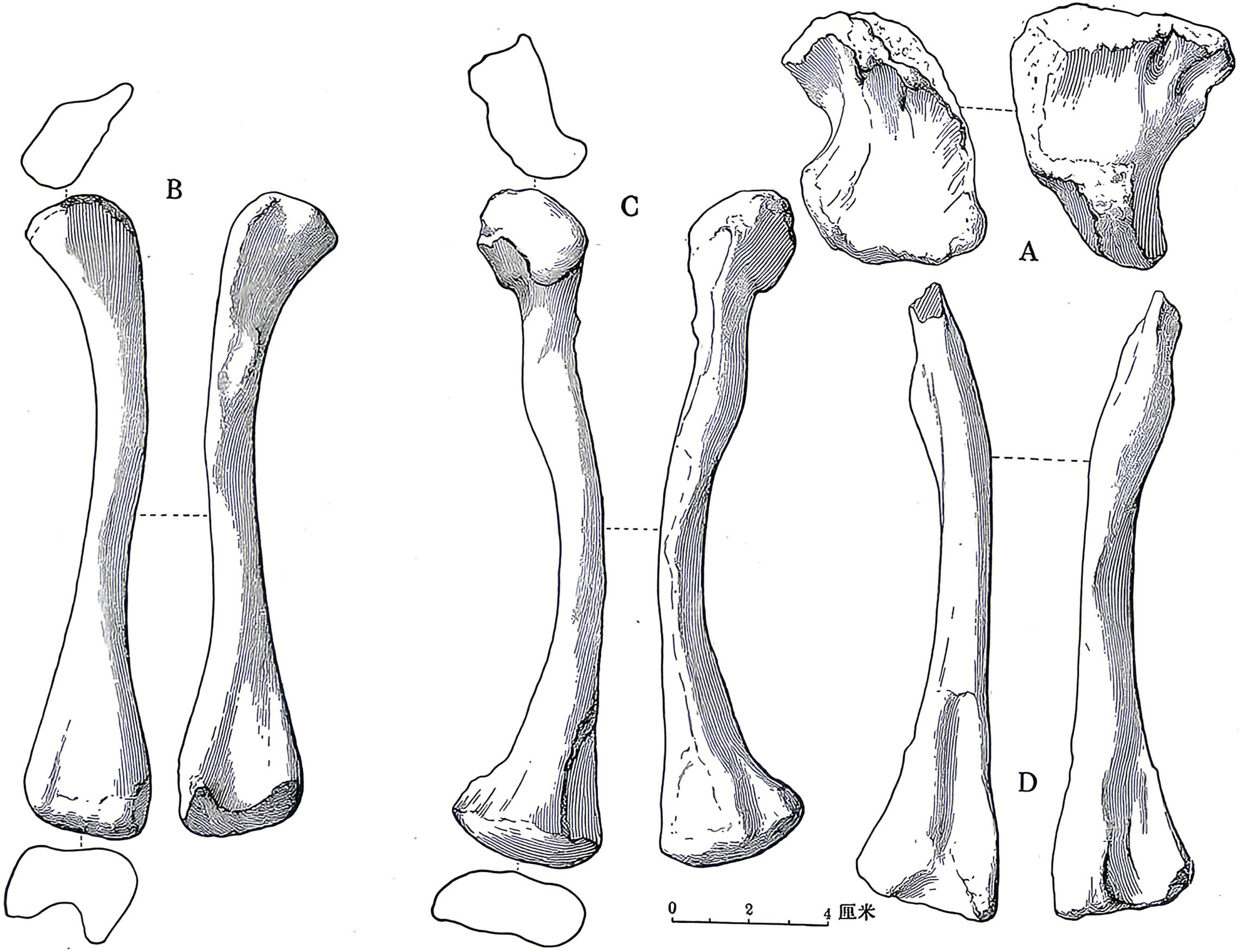


图 58　择 义 王 氏 鳄，新 属 新 种

A. 左耻骨； B—D. 三股骨。詳見正文。均原大三分之二。

Fig. 58 *Wangisuchus tzeyii*. gen. et sp. nov. A. left pubis in two views; B—D. three left femora in different views with outline of the both ends; B. normally develeped while C and D much distorted and pachyosteous. 2/3 nat. size.

鳄来，脛骨較为伸长而纤細。其长度估計起来，应不亚于 180 毫米。保存比較好的脛骨，其近端只部分完好。骨干部由上向下逐漸变細，直到稍微加粗部分，表示距远端不远。这一脛骨保存的总长为 166 毫米。无論如何，脛骨宽比股骨长的多。图 59 C 的近端的內側前后长为 41 毫米，宽为 34 毫米。图 59 D 的同一相当尺度为 33 和 24 毫米。骨的破裂处也表示骨壁相当之薄，說明和股骨的連系是正确的。

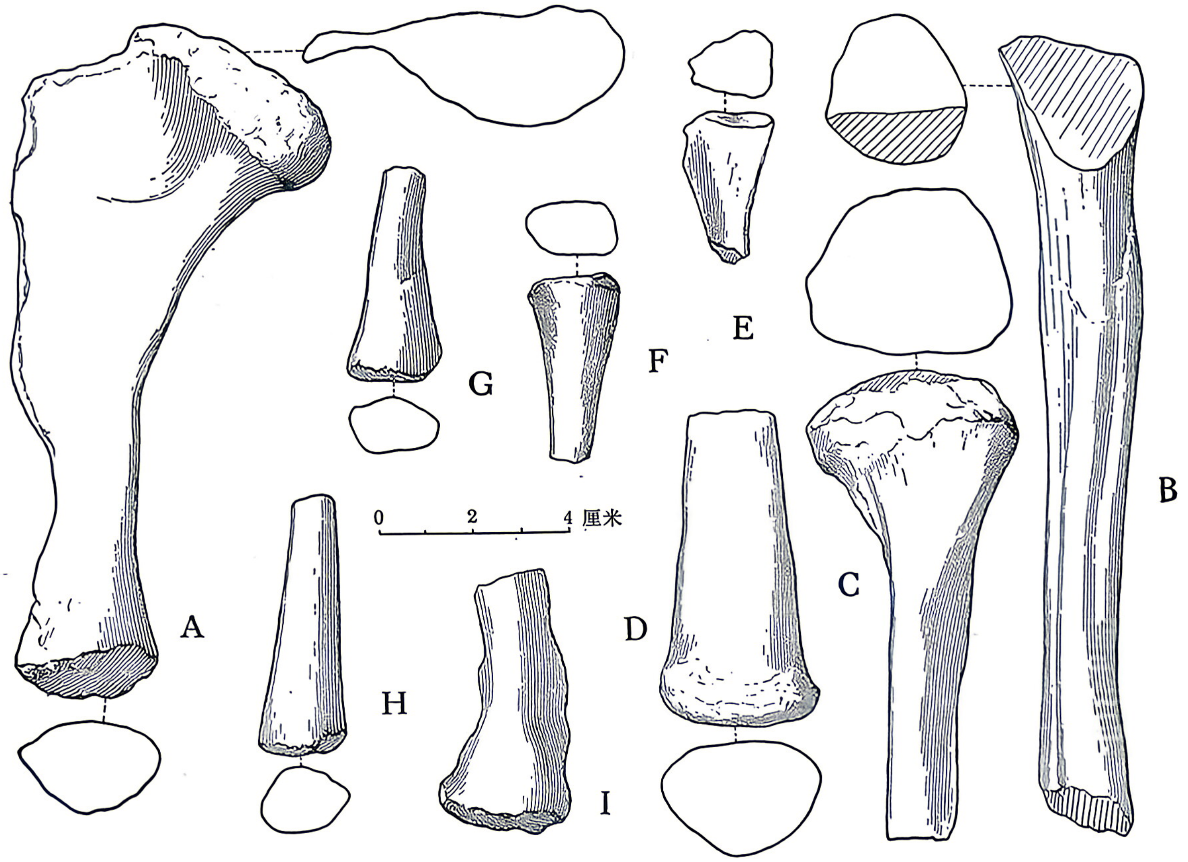


图 59 择义王氏鳄，新属新种

A. 左坐骨； B—D. 脛骨； E—F. 5523 腓骨； G—I. 腓骨。詳見正文。均原大三分之二。

Fig. 59 *Wangisuchus tzeyii*. gen. et sp. nov. A. left ischium in lateral view with the proximal and distal outlines; B. a nearly complete tibia; C. proximal part of a tibia; D. distal part of a tibia with the outline of the preserved ends; E and F. probably two fibula bones from 5523, ?proximal end; G—I. three distal parts of ?fibula. 2/3 nat. size.

**腓骨**：有許多这一骨的碎片，但沒有一个是比較完整的。自 5523 地点有两腓骨，可能为近端（图 59，E 和 F），另外来自 56173 地点的三个远端（图 59，G—I）为比較好一些的标本。最后一个比較大而宽，其归于这一种，不无疑問。腓骨的两端都比較厚。总长无法估計。近端的宽和长：图 59 E，15×19；59 F，13 × 19 毫米。远端的宽和长：图 59 G，12×19；59 H，15×18；59 I，17×27 毫米。其他沒繪图的腓骨，过于破碎，无何可以特别記述的地方。

**距骨**：根据其大小和构造，我們把图 34 D 的一左距骨归到这一新种。这个骨很象以前定为袁氏加斯馬吐龙的跟骨（看来也应为距骨，楊，1936）。它的外側，窄而高，有一与跟骨接連的面，內側相当的宽。背側相当凹入。前边一面，有一深的凹陷，其下有一横的浅沟。这个距骨和山西鳄，汾河鳄的距骨都很不相同，而和新巴氏鳄的距骨却有些共同之处，只是外側更窄一些，横宽 38 毫米。外側高 25 毫米。內側的前后长 30 毫米。比較平板状的距骨构造，表示一相当原始特性。

**跟骨**：有一右跟骨（图 60，A）。和較原始的距骨相反，跟骨很为特殊化。其一般构造和 *Episcoposaurus*

(Huene, 1915, P.495) 和 *Stagonolepis* 的跟骨有些相似。不过我們的标本显得更长一些。茎状伸出或突起发育的很好。长 28 毫米，宽(連同突起部分) 23 毫米。

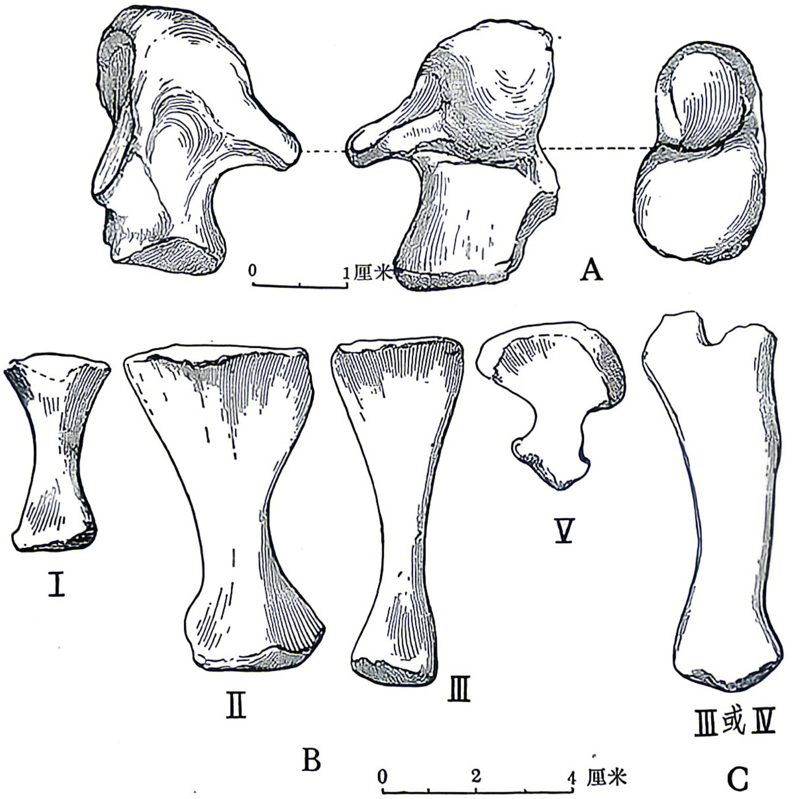


图 60　择义王氏鳄，新属新种

A. 右距骨三面观，原大三分之四；B. 若干足掌骨，I—V. 表示趾数；C. 5535 地点之 Mt. III 或 Mt. IV. 詳見正文。原大三分之二。

Fig. 60 *Wangisuchus tzeyii*. gne. et sp. nov. A. right calcaneum in anterior, posterior and lateral views. 4/3 nat. size; B. some metatarsals in dorsal views, number digit as marked. Apparently right side; C. probably a metatarsal III from 5535 (V. 2707). 2/3nat. size.

这个跟骨如此特长而进步，因而它究竟是否归于这一种，不禁起了疑問。另外一方面，大小和这一种很合适，而所述的各假鳄类的跟骨，在构造上都很不相同。所以我們还認为很可能这两个足上的骨骼属于同一种动物。而此等不很調和的連系，可能正代表这个动物的特性之一。

**足掌骨**：一些完全的足掌骨見于图 60B。另外还有两个足掌骨的近端。从 5535 地点有一 Mt. III 或 IV (图 60, C)，从 56173 采的几个足掌骨可能为 Mt. ?I, Mt. II, Mt. III 和 Mt. V, 自左至右，如图所示。第一个作 Mt. I 好象太小一些。所有这些骨比起新疆袁氏加斯馬吐龙来，稍为粗壮一些。和这一种的足掌骨也有些相似，但我們的种的足掌骨两端特别宽一些。和新巴氏鳄相比，特别小，两端也特别显得宽而大，比这个种至少大两倍。Mt. V 的近端很宽，末端也較加粗。5535 地点的一足掌骨作为 Mt. II 或 Mt. III 显得宽一些，可能由于稍受挤压之故。两端均保存不佳。但就一般形状論，其应为一足掌骨似无疑問。总长，近端和远端宽度分别为：Mt. I, 40, 23 和 18 毫米；Mt. II, 66, 38 和 27 毫米；Mt. III, 73, 28 和 17 毫米；Mt. V, 36, 33 和 17 毫米；Mt. III 或 IV (5535) 79, 28 和 22 毫米。

## 甲　　板

毫无疑問，这一种动物是具有甲板的，因为背脊椎的背棘末端相当加粗。从构造上講，材料中有些甲板，非常特别，归于汾河鳄，不无疑問。但在另外一方面，有些甲板归于这一种，可能还是大了一些。此外，这些

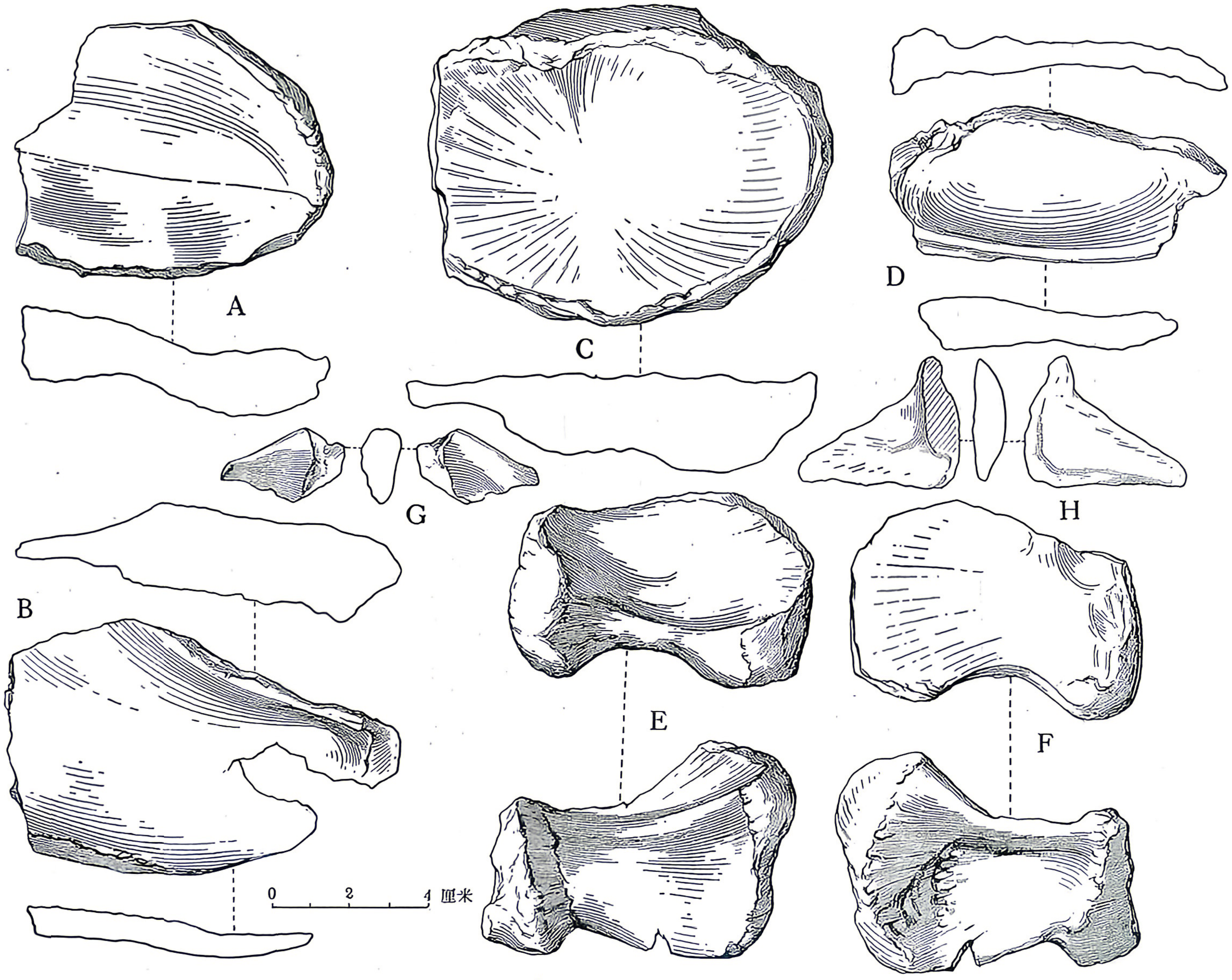


图 61　择义王氏鳄，新属新种

A—H. 甲板，詳見正文。原大三分之二。

Fig. 61　*Wangisuchus tzeyii* gen. et sp. nov. Dermal scutes probably belong to this species. Details see text. 2/3 nat. size.

甲板在身体上的确实位置,彼此排列关系也很不清楚。 其中有少数甲板归于上述种或是代表一还未知的种类的可能性还不能完全排除。

在目前要描述的甲板,大体上可以分为三类:

**1. 大而椭圆状的甲板**(图 61, A—D): 这一类甲板或多或少作椭圆形輪廓,一边較厚,一边較薄。它們都是一边凹入,一边凸出。两边的表面,都是光的毫无其他花样。 可能这凸出面代表向外的一面。 最大一个(图 61, C) 长度估計为 120 毫米,宽 82 毫米。几乎和汾河鳄的中等大小的甲板一样大,但构造上大不相同。

**2. 較小而横向拉长的甲板**(图 61, E—F): 这类甲板的两端均加厚,好象窄的一端为內側,而宽的一端朝外。E 的当作外側的一面(背側)为凸出的面,另外一面为凹入(腹側); 在 F, 向內一面相当之平。 这一类甲板可能位于尾較前部。总长和两端宽:图 E, 80, 41 和 57 毫米; 图 F, 75, 42 和 45 毫米。

**3. 小而一端尖的甲板**(图 61, G—H): 这一类甲板和一些認为是归于这一种的脊椎骨一起发見,所以很有兴趣(56157 地点)。它們都很小,向內关节的一端較厚。其輪廓为三角状,尖端朝外。 背側凸出的一面有輕微的雕刻紋,而凹的內側光滑。这等甲板看来为边緣上的甲板。横宽:图 G, 43 毫米; H. ? 35 毫米。

## 鉴 定 与 討 論

这四个上顎骨,如已記述的,具有相当充分的特性。它們和以前討論过的两属的上顎骨,有显著的不同之处。另外,所有大多数头后骨骼(如不是全部的話),也应当归于这些头骨的头后骨骼。只有极少数可能有些疑問。这些骨的大小和构造,一般都很适合,特别是脊椎骨和大多数四肢骨。在大小上,有时不可能在黑峪口山西鳄和这一种間划一明确的界限。总的說来,我們必須承認,这一新种代表一很清楚的由解剖学上特性决定的新种。起初乍一看,如伸长的頸脊椎等,好象觉得这一种和加斯馬吐龙不无关系。但稍一仔細研究,就可以知道和这个种决无关系。这新种的牙齿为半槽齿式的,背脊椎的背棘末端加粗等,明显的排斥了进一步与之比較的可能性。

另外一面,非常清楚,我們这一种和为甲板所全包的(以 Aetosauridae 为代表)以及沒有甲板的 Elachistosuchians 无何关系。所以我們这一种很可能应当归之胡佛斯特(1955)所加以規定的鳥鳄类这一超科。在我們叙述过程中,我在有些性质上和新巴氏鳄加以比較。 好象把我們的新种归于这一亚科, 沒有太大的問題。上顎骨的形状,再加上沿眼前孔边上加深的性质,以及腰带骨的一些性质,都支持这一假設。 我們的化石比之新巴氏鳄相当之大,此外有許多性质和上指的属很不相同,如頸脊椎的拉长, 背棘末端加厚, 恥骨特短,和特殊的甲板等等。很清楚,这是一个新的假鳄类,拟命名为择义王氏鳄,新属新种,其特性已列举于前。属种名字为紀念王择义先生在山西所作的很多的古脊椎动物采掘工作,所付出的劳績。

虽然这許多骨骼的彼此联系不是很清楚,大多数是零星找見的,年龄也不尽同, 但我們仍設法估計出一些数字和比例,作为对于这一动物进一步了解的根据。

从上顎骨的长度来推测,王氏鳄头骨之长应不小于 220 毫米。这个动物应为一个中等大小的假鳄类。

各部位脊椎骨的数目,无法确知。但大体上可能是:頸,十;背,二十五;荐骨,三;尾,五十或更多。 动物的总长,估計为 1500 毫米。

其他各部位的比例見表 15 (頁 181)。簡言之, 即橈骨对肱骨, 62; 手骨对肱骨, 23; 脛骨对股骨, 103; 足掌骨对股骨, 45; 肱骨对股骨, 118; 前肢对后肢, 75。

把这些数字和寇伯特(1952)所作的关于鳥鳄类相当数字来比,沒有一个是相近的,肯定我們的种不归于这一科。

至于新巴氏鳄的四肢骨,所知太少,沒有可以对比的資料。

根据由各不同四肢骨所能得出的結論来講,至少王氏鳄应代表鳥鳄超科中相当特殊化的一种。 如背棘的加厚,荐骨脊椎的增加,烏喙骨和恥骨的特殊样子等。甲板的形式也很特别, 比起 *Stagonolepis* 等来不很发育,但比起 *Euparkeria* 还是发育一些。

尽管这样,这一新种,还有一些較原始的性质。如較长的頸脊椎,較长的前肢,和比較上不那末发育的甲板等。所以王氏鳄可以当作一些原始性质和一些进步性质混合起来的一种动物。可以設想, 王氏鳄应当是

和晚三迭世眞正的鳥鳄类祖先相近的一种，即便不是眞正的祖先。

脛骨比股骨为长这一性质，加上薄的四肢骨的骨壁，也許表示这个动物和后期的虛骨龙类有些关系。尽管前肢长一些，但两足化的趋势，清楚地已經开始，这性质比起山西山西鳄来，还要显然一些。

由牙齿和四肢骨看来，王氏鳄当为肉食性的，生活于內陆地区。比起山西山西鳄来較为跑的快一些，較为活跃。

# 結　　論

这一动物羣的結論，可以分七部分来講：

## 1. 动物羣的組成

在山西的中国肯氏兽动物羣中，假鰐类为十分丰富的一部分。除已描述过的所謂袁氏加斯馬吐龙现改为最后加斯馬吐龙(見下)外，其他假鰐类均于前各章加以記述和討論。全部山西三迭紀的假鰐类可見表 16 (頁 182)。

在这一表中，一共有五种假鰐类，分属于三个超科，四个科。除了重要的 Sphenosuchidae 和不太詳知的 Elachistosuchuidea 以外，其他重要門类的假鰐类在这一动物羣中均有代表。除了最后加斯馬吐龙只有一个标本为代表外，其他的种，都有相当多或很多的个体为代表。它們的分布，一般說来，也是很广的。

所以我們可以認为，目下的这些假鰐类代表迄今为止，我們所知的个体最多、分布最广的假鰐类化石。

## 2. 山西三迭系各地点的脊椎动物化石

在沒有討論山西的假鰐类动物羣以前，很有必要就产地的分布，把所有研究过的化石，加以总結。除了两栖类的迷齿类以外，其他的化石都已研究过，所以我們有可能作这动物組成的調查工作。迷齿类的化石，保存不佳，就已有材料看只有可能属于大头龙(Capitosauridae)一科的一种动物[1]。

关于各地点的化石內容見表 17 (頁 183)。

在表 17 所列举的化石中，沒有包括周明鎮和孙艾璘(1960)所描述的来自林遮峪黄河保德蜥和楊(1961)所描述的林遮峪河套兽两种。这个地点的化石年代，还不十分肯定。根据周和孙的記述，化石是产自二馬营羣下部，距以下石千峯組只有七十米。可是根据我們一再的研究，包括孙的最近研究(1963)在內，新前稜蜥产自武乡区二馬营羣的第三化石层，而林遮峪层则距石千峯組的頂部只有七十米，显然在上一层之下。又据王择义的野外观察說，林遮峪地点的层位应在石千峯組的上部。因而很难認为林遮峪层是和大多数二馬营羣化石为同层的。由化石性质来說，还很难有充足的結論，不过河套兽是一个很特别的犬齿兽类，保德蜥究竟如何还不清楚。就其牙齿看，也可能为一特別的另一种犬齿兽或其他动物。因之我們有理由相信，林遮峪这一层比含中国肯氏兽的层位要老一些。或者代表二馬营羣最下部，或者代表石千峯組的上部。那就是說更要老一些。

現在再回到表 17 的討論。由这个表可以看出，在主要的大多数化石地点，肯氏兽和假鰐类是共生的。中国犬顎兽，在 5523 地点的存在特別重要，因为这个种可以和南非犬顎兽层的下层的犬顎兽相比較。

来自 56173 地点的亚洲新前稜蜥本身对于鉴定年代帮助不大。在构造上它比前稜蜥进步，和中国肯氏兽共生，这一属在这一地点，按孙艾璘鉴定作为可与中国肯氏兽相比的化石，是否为眞的中国肯氏兽，尚未完全肯定。中国肯氏兽的层位，比起其他肯氏兽化石应当稍老一些。

所有其他兽形类二种，卽山西兽属都和肯氏兽和假鰐类一起发見。

在我們早先的初步研究中(楊，1957；楊和其他人，1959，1959A)，都把武乡区域含化石层分作五层[后来也为孙所采用(1963)]。在层序上自然毫无疑問，下一层比其上者为老。中国肯氏兽一属也許比較原始一些，但有些地点和山西鰐共生，大大地減低了其重要性。至少就表 17 所列举各化石內容来分析，看不出任何古生物方面有何明确的分界地方。二馬营羣就其化石內容来講，代表一单一的，具有重要特性的动物羣，这就是丰富的肯氏兽、假鰐类，和一些具有特性的其他化石，如中国犬顎兽，新前稜蜥与特別的加斯馬吐龙。

这个动物羣，分布很广。向西北分布，一直到宁武和黄河东岸的兴县。这个事实表示二馬营羣在山西(可能也在陕西)是較为稳定的一个动物羣。在兴县所找的山西鰐的两属看来，在保存上比武乡还好，有找到

1) 見第 3 頁脚注。

完整骨架的希望。

在表 18 中,我們把到目下为止,在我国已发見的二迭紀、三迭紀脊椎动物化石作一小結(頁 184)。

由这一表可以看出,自上二迭統起到上三迭統,已有了六个不同的化石层,各有代表性的化石,比以前所知的,增加了石千峯和林遮峪两层。可以预料,这些地方的二、三迭系是大有前途的。

关于表 18,有几个問題可以附带談一下。

第一,关于新疆二齿兽,最近孙艾璘(1963)把它当作和肯氏兽有关系的一种二齿兽,并改名为新疆吉木薩尔兽。眞正的新疆二齿兽层位,还不太清楚,但有可能比水龙兽一层老一些,并不支持孙的这个意見。从化石性质来說,嘴部很尖,顳顬孔特別大等性质也不完全支持这个意見。一般的看法認为肯氏兽的祖先应当先在水龙兽或其近似的种中去寻找(Toerien, 1953)。

第二,最近由孙艾璘在山西保德石千峯組中找到了两架不完整的杯龙类骨骼。初步观察,可以大体肯定应归之上二迭統,因而增加了关于二迭紀、三迭紀脊椎动物一个新层位。这个发見将在另外場合,加以描述[1]。

第三,1959 年时曾在宁武的石盒子羣中发見了可能是魚牙的一个牙齿化石,又在另一地(山西太原)的同一羣中找到魚鱗。两材料均待仔細研究,但肯定代表二迭紀中最早的一个脊椎动物化石层位。

## 3. 中国假鰐类研究的回顾

为了使我們得到到现在为止,中国的假鰐类的全面計,最好把所有已知的假鰐类加以全面的探討。尽管大多数这一类的材料都是十分破碎的,但还是有一定的用处。

### 袁氏加斯馬吐龙(*Chasmatosaurus yuani* Young 1936)

**层位与产地**:新疆吉木薩尔水龙兽层,野外編号 900002。

**材料**:一头骨的前部,連带下顎骨和一些脊椎和四肢骨。

**注释**:为一标准的加斯馬吐龙。前顎部向下作特有的弯曲。牙齿也有特性,向后显著地弯曲。脊椎还具有間椎体。在原本第十三图 b 所列入未能确定属种的一肱骨,看来很可能就是这一种的肱骨。在同一图 e,原当作右跟骨,应为距骨。

从袁复礼所采集的材料中,最近还看到一些加斯馬吐龙的新材料,在同一区域,但为另一个地点——新疆吉木薩尔大东沟(600068)。这是无疑的归于袁氏加斯馬吐龙的材料。好象和水龙兽在一起,加斯馬吐龙为常見的一种动物[2]。

### 最后加斯馬吐龙(*Chasmatosaurus ultimus* sp. nov.)新种

1958. *Chasmatosaurus yuani* Young, C. C. On the occurence of *Chasmatosaurus* from Wuhsiang, Shansi. lest. pal. 259—262

**材料**:一破的头骨。V. 2301。

**层位与产地**:中三迭統下部或下三迭統上部,武乡楼则峪石片沟(5537)。共生的化石有武乡山西兽和黑峪口山西鰐,也可能和肯氏兽未定种共生。

**注释**:以前定名为袁氏加斯馬吐龙,有必要加以改正。在主要性质上如上下顎和牙齿,都是很标准的加斯馬吐龙类型。但 5537 的地点的标本,比原来袁氏加斯馬吐龙小的多。它的牙齿也特別向后弯曲。特別是牙冠底部較长一些。經过再一次仔細考虑,認为 5537 的标本,应当作一新种,起名为最后加斯馬吐龙。这一新种名用来表示最后加斯馬吐龙,并不代表含中国肯氏兽层以前的一新层位,而是和这个属及其有关各属为同一层位。在最初观察这个动物羣时,曾錯誤地把武乡山西兽当作水龙兽,以后研究結果,証明并无这一属的存在,而二馬营羣动物羣,代表单一的生物羣,最后加斯馬吐龙不但代表这一属的最后一种,而且也是这一科(Proterosuchidae)的唯一殘存。

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1) 此材料在本文付印后已发表,見楊鍾健、叶祥奎,1963:鋸齿龙在我国的初次发現,古脊椎动物与古人类,7 卷 3 期,頁 175—212。

2) 此材料在本文付印后已发表,見楊鍾健,1963:新疆加斯馬吐龙的新加材料。同上,頁 215—222。

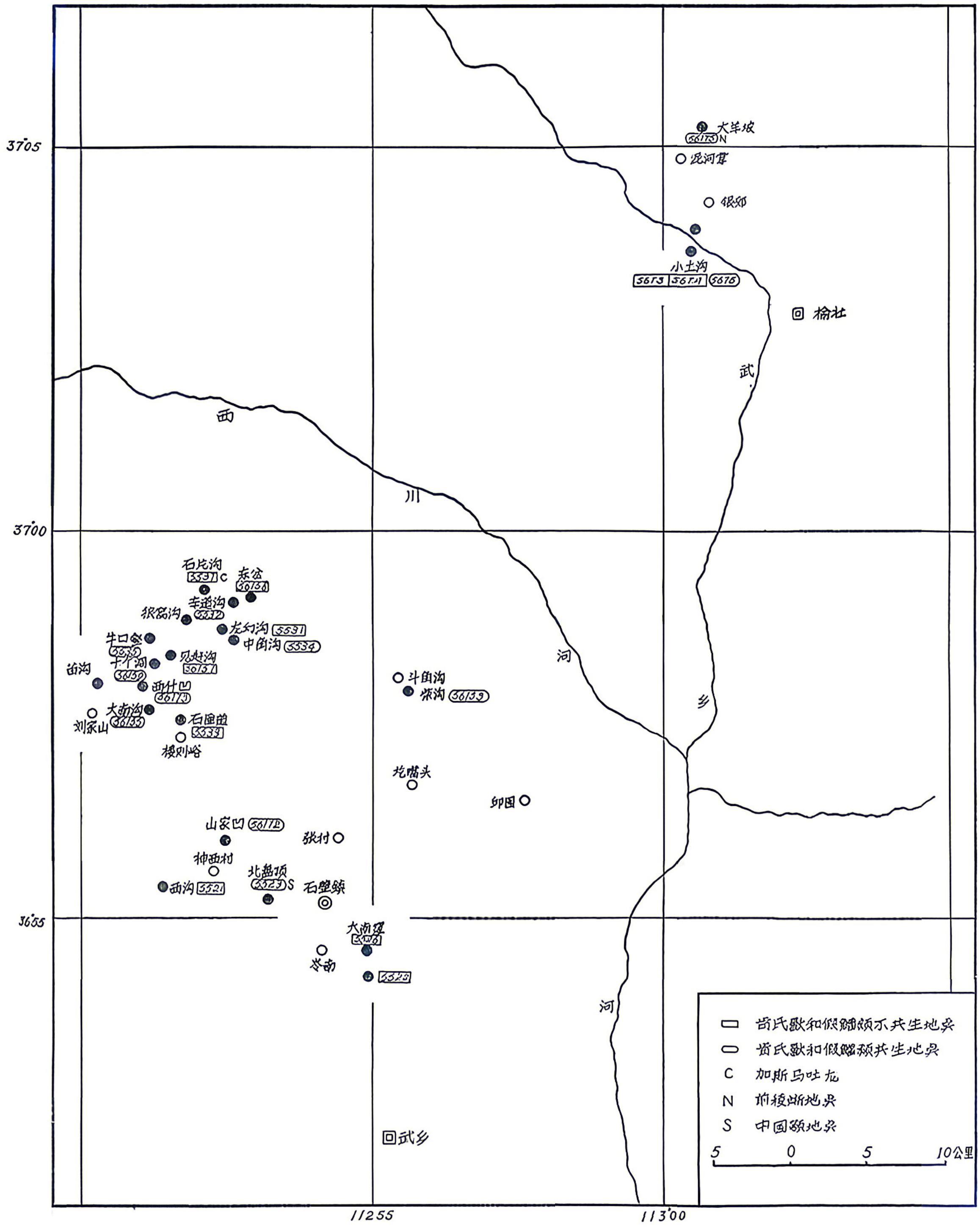


图 62　山西武乡、榆社的脊椎动物化石分布图

Fig. 62　The distribution map showing the geographical occurence of vertebrate fossils in the Wuhsiang-yueshe area. Rectangles, kannemeyerid associated with pseudosuchians. Rounded rectangles, kannemeyerids not associated with pseudosuchians. C, N and S. locality with *Chasmatosaurus ultimus*, *Neoprocolophon asiaticus*, and *Sinognathus gracilis* respectively.

在原描述上,关于眼前孔的长度,誤为 17.5 毫米,应为 47.5 毫米。

### 許氏扁鰐蜥（*Platyosgnathus hsui* Young 1944）

**材料**: 一对下顎的前部,具有殘破的牙和牙孔。

**层位与产地**: 晚三迭世下祿丰羣。云南祿丰黄家田。

**注释**: 对于以前所述,无何可增加之处。两下顎的愈合和犬齿化的牙,非常特殊。可能为一最晚期的假鰐类。許耐于 1956 年把这一属放在新巴氏鰐这一科。根据現在的研究,特别是王氏鰐的研究，并沒有为这个說法提供証据。許氏扁鰐蜥看来为一相当畸形的假鰐类。 但由于材料不充足,难作任何进一步的推断。

### 甲板小鰐（*Microchampsa scutata* Young 1951）

**材料**: 十一个脊椎骨和三排列甲板。

**层位与产地**: 同上。

**注释**: 这一种的材料,也很不完全,沒有什么可以补充的。在以前的記述中,我曾把它归之原鰐类。 許耐在 1956 年归之 Spheneosuchidae 科,但也認为有归原鰐类的可能。他最近的意見(1962)，对两个可能性幷未肯定。在下边中国假鰐类的表中,只是暂行把它归入,而不排斥其和原鰐有关的可能性。

### 不全碩鰐（*Pachysuchus imperfectus* Young 1951）

**材料**: 一头骨的碎块。

**层位与产地**: 同上。

**注释**: 这是在中国到现在所知道的唯一副鰐,和假鰐类最近,同归于槽齿类。但因材料不全，能增加的有限。但可以說明,这一亚目在我国是存在的。問題是象山西这末丰富的动物羣中,竟未找到这一亚目的存在是相当奇怪的。

根据上述,我們可以把到目前为止在中国所发見的槽齿类化石列为表 19 (頁 186)。

在这一表中,主要分为三层,最上层为云南祿丰的下祿丰羣,一共有三种化石(已見上述)。 含这一些化石的下祿丰羣的年代,极可能为瑞替克期,卽晚三迭世晚期。但是不能排斥这一可能性，卽它的最上部可能引伸到里阿斯期,但絕不能更高。含这三个槽齿类的黄家田地点的层位比下边的含卞氏兽的层位高的多,所以有可能稍新一些,一如伍尔森等(1963)最近研究云南祿丰一哺乳动物所指出的。

当中一层卽为山西武乡等地的化石层,包括有在本文中所研究或改定的五种假鰐类。

最下为在新疆发見的以水龙兽和加斯馬吐龙为代表的归于下三迭統的一层。

所以非常淸楚,山西假鰐类的发見,大大地增加了关于这一門类知識，也塡补了地层上一向所缺的一大空白。山西的化石比起上下两层来,材料丰富,保存較好。

## 4. 中国肯氏兽动物羣和其他地区的比較

### A. 和南非哈魯系的比較

在我們关于山西爬行动物的研究中,几乎每一种都可以和南非哈魯系的有关种或多或少可以比較。 此等关系可以由表 20 表明(頁 186)。

据孙艾璘关于肯氏兽的研究,所有山西的两属五种，都和南非的 *Kannemeyeria simccephalus* 較为接近。中国大顎兽和南非犬顎兽层有关属也很相近。目下关于山西的假鰐类的研究中,特别是大型山西山西鰐,和尽管看来只为一眼前孔的非洲引鰐特别相近。象我以前所指出，南非引鰐的眼前孔数不是不可以加以怀疑的。如果眞的話,它們的关系还要更密切一些。王氏鰐和南非新巴氏鰐的关系，虽不如以上的情况，但也有許多点对其相互关系頗有启示。在山西的化石名单中,有新前稜蜥和加斯馬吐龙两属,較为有些問題。依照野外观察的剖面,認为这两种化石,均产自剖面的中部,卽为第三骨化石层,不可能在更低处。那末唯一的解

释就是，它們的层位实际上較高一些。这实际上也就是重要理由之一，为什么我們認为这动物羣的年代，可能包括一部分早三迭世晚期，因为还含有一些比較古老的成分。

总而言之，把山西含中国肯氏兽这一动物羣，包括許多假鰐类在內，当作可以和南非哈魯系含犬齿顎层的同时代产物对比是十分清楚的。

## B. 和苏联的假鰐类化石层比較

在苏联，假鰐类化石相当丰富，1960年塔塔林諾夫把到那时为止，在苏联所发見的假鰐类化石作了一个修訂。除了产自第四层，年代較老的初龙（*Archosaurus rossicus*）以外，其他均产自第五到第七层，也就是三迭紀的。塔氏的修訂以及原来的鉴定和与我們种类的关系，見表21（頁187）。

关于第一种（*Chasmatosuchus rossicus*），我們在此无多可講。此化石产自第五层，属于原鰐科（Proterosuchidae），可以和南非的水龙兽层相比拟。

但是关于以下五种，問題就很大。我在此不打算詳細討論关于塔氏所作的修訂，卽把所有在苏联找到的四种假鰐类（Zone V—VII）都認为可归于南非的引鰐一属。卽就是認为只是一属。如果眞的如此，那实在太好了。至少从加氏鰐（*Garjainia*）的左側的图来看，我非常怀疑，它和引鰐以及我們的山西鰐有什么近似之处。最主要的根据是那高而斜的单一的眼前孔。其向下傾斜的前顎骨部，也和两者不一样。它的方骨很向后傾斜，亦不相同。在大小上比南非的引鰐小的多。

*Chasmatosuchus vjushkovi* 非常不完全，还很难肯定。卽迹塔氏也認为可能只是年輕个体，归于他的所謂引鰐。

关于 *Dongusia colorata*（照伍尔森和塔塔林諾夫的說法，这个化石来自 Zone VI，而非如許耐認为产自水龙兽层）和 *Vjushkovia triplicostata*，大小相近，至少在大小上可能有些可与我們的黑峪口山西鰐相比之处。在构造上，所有这些属种究竟眼前孔的数目和形状如何，完全不很淸楚，因此，很难談到它們的亲緣关系。但有一点却是肯定的，就是絕不会是眞正的引鰐。在引鰐这一科中，除了許耐所描述的标本以外，所有其他知道的头蓋骨都沒有顶骨孔发育。两种都比眞正的引鰐小的多，此外还有許多次要的区別。*Dongusia colorata* 只有一个脊椎，但很具有特性，未在我們材料中淸楚地看到。同样的情况，如在 *Vjushkovia triplicostata* 很具特性的肋骨多一关节头，也未在我們材料中淸楚地看到（只有一个脊椎可能有）。

所以看来这些后期的苏联的假鰐类不能簡单地归于一个属是很显然的。近来一些作者（Kuhn, 1961; Huene, 1962）都未这样做，甚至还当作个別的科，也支持我們的看法。

关于苏联假鰐类的鉴定尽管有些不同意見，但大体对于我們山西动物羣应和苏联的 Zone V 和一部分 Zone VI 相比較还是十分淸楚的。含 *Garjainia* 的层位可能稍老一些，为第五层之頂部。

至少在目前，我們必須承認，尽管两地区比較邻近，几乎所有在中国发现的假鰐类，沒有一个可以和苏联的种严格地作比較，或在那里发見。在苏联沒有犬顎兽，沒有新前稜蜥等化石。而在我国，迷齿类的大头龙，保存很不好，成为不能作滿意对比的主要原因。

## C. 和其他地区的比較

除了上述两个地区以外，其他地方沒有可以和我們的动物羣作較近的对比的。但是在西半球，可以指出有两个动物羣，和我們的不无一定的关系。

一个是在北美阿里佐納州上門冠辟建造，其中含有阿里佐納龙（*Arizonasaurus babbitti*, Welles 1947），这一种动物的上顎骨，特有兴趣，其上突起非常靠后，顎骨內凸而外平，牙列上有曲折形三角状骨板等，都和山西山西鰐一样。非常可能这个阿里佐納龙和我們的山西山西鰐有相近的关系，至少可归于一科。而門冠辟建造的年代，可能和我們的二馬营羣同时或等于其下部。支持这个說法的为将要于以后描述的也和山西山西鰐共生的迷齿类化石，初步观察，至少就脊椎骨言和門冠辟所发見的也很相近。

許耐在1956年把阿里佐納龙均归之 Stagonolepidae 一科，看来不太可能，他在1962年又列于科不能肯定的表中，现在看来和中国假鰐类不无近似之处。

另一地区为在南美阿根廷伊士奇圭亚拉斯脱（Ischigualastis）的动物羣。我們所掌握的材料，还不能对这一地区的动物羣作詳細介紹和討論，特別是最近的发見。但1958由瑞格（Reig）所描述的两种归于中三迭世的爬行类，很有兴趣。一为一种原鳄（*Proterochampsa barrionuevoi*），一为一假鳄类（*Saurosuchus galilei*），似乎可以和我們的山西假鳄类有些可以比較之处。这个假鳄头长650毫米，是一个比較大的动物，按瑞格应归鳥鳄科，比我們的王氏鳄大的多。但上顎骨的形状和牙齿的构造却有些可以比較之处。另外自同一地層中还发見了一大的二齿兽类化石，头长550毫米，寬460毫米，被柯克思（Cox，1962）定名为 *Ischigualastia jenseni*，但无附图，詳細記述还未发表。如这一新的二齿兽和肯氏兽科有些相近之处，那将毫不奇怪。按照罗美尔，这个地层的年代为中三迭世，可以和巴西的 Santa Maria 层或坦噶尼喀（Tanganyika）的 Manda 层相比。因为关于阿根廷的化石还所知不全，而我們山西化石的年代肯定稍老一些，所以任何这样的对比，都是初步的。在阿根廷北部还发見了一假鳄类，名 *Argentinosuchus*（許耐，1962），但我們还沒有可以下任何判断的材料。

以上所討論的对比，可以总結为表22（頁189）。

## 5. 分类与輻射

关于槽齿类目（包括两亚目：假鳄类和副鳄类）的分类，近年以来許多作家都有所安排［許耐，1956；Piveteau（关于槽齿类由 Hoffstetter）；罗美尔，1956；孔，1961］。这些分类从根本上說，在亚目和科的分类上十分相同，无大区别。

最近許耐（1962）在他的一篇文章中，把假鳄类作为大多数侏罗白堊紀陆生恐龙类的基層門类，給这一类的分类带来一个重要的改变。对于他的論証，即假鳄类和后期初龙类的关系，我們大部分同意，但在分类上还有可以討論之处。他取消了原来用的超科，把假鳄类分作六科，包括四十八属（未包括 Reig 的 *Saurosuchus*）中的三十八属，而另外的当作科的关系尚不能肯定处理。

第一科是 Proterosuchidae，包括 *Archosaurus*, *Proterosuchus*, *Chasmatosaurus*, *Chasmatosuchus* 和 *Elaphrosuchus*。这和以前这一科所属根本无区别，只是去它的超科的帽子。

第二科为 Sphenosuchidae，包括了十八个属，如 *Sphenosuchus*, *Rauisuchus*, *Prestosuchus*, *Erpetosuchus*, *Elachistosuchus*, *Vjushkovia*, *Euparkeria*, *Stagonosuchus* 等。就这些属的大小上，构造上，地质年代上講，很难相信这些属属于自然的一科。

第三科为 Erythrosuchidae，包括 *Erythrosuchus*, *Dasygnathus* 和 *Dongusia*。这和以前的分法也无大区别，只是沒有超科了。

第四科为 Ornithosuchidae，包括 *Ornithosuchus*, *Hesperosuchus* 和 *Clarenica* 三属，与前大致相同。

第五科 Sceleromochidae，只包括 *Sceleromochlus* 一属。

第六科 Aetosauridae，包括的成員基本上是 Walker（1961）所修訂的关于这一科的分类（見上，頁67）。

在另外未归科的属类中和我們本文有关的一些属为 *Arizonasuchus*, *Garjainia*, *Platygnathus* 和 *Microchampsa* 等。

关于一、三、四、五和六等科的內容因为基本同以前改变不大，我們无多可以补充。只是关于第二科 *Sphenosuchus* 这一属和鳄类有相当近的关系，还觉得应当当作独立的一科的代表。而較大的 *Rauisuchus* 一属以及与之相近的属，由于前顎骨具有发育很好的牙齿，和不完全发育的甲板，似也应当作独立的一科。同样，*Euparkeria* 和 *Ornithosuchus* 虽相近，但有一定的区别，进一步講，好象如能保留原来的有超科的办法，可能更清楚一些，如 Proterosuchidae 和 Erythrosuchidae 合为 Proterosuchia, Euparkeridae 与 Ornithosuchidae 合为 Ornithosuchoidea 等。

因此，我們觉得，至少在目前，采用孔氏的关于假鳄类的分类，比較合适。不仅以为他是較新的一个分法，而且也較为自然一些。自然也可以作小的修正。

这个分法，見表23（頁190），也就是把假鳄类分作六大超科（图63，頁92）。

在以上六个超科中，前三超科，在我国均有其代表。可能第五科也有。第一超科 Proterosuchoidea，包括

三科,为 Proterosuchidae, Erythrosuchidae 和我們的新科 Shansisuchidae, 如果引鰐能确切証明有两个眼前孔的話,可能要归入山西鰐科。 *Vjushkovia* 一属,无論作为一科也好,作为一属也好,有可能归入此超科,而不一定归 Ornithosuchoidea。因照塔塔林諾夫的观察,虽然不一定与引鰐同属,但还是有些相近的。这一超科也就是罗美尔(1956)当作和假鰐类相平行的一个亚目。至少就山西山西鰐言,其前颚骨除了向后突起稍高,分开鼻孔和眼前孔以外,并不怎末特殊化(事实上 *Elaphrosuchus* 的前颚也有此倾向)。所以非如許耐(1963)所云和他的第二科很近,而仍是和引鰐等相近。

第二超科包括了許多科,但都具有較伸长的头骨和肉食性的牙齿。 这一类动物比起前一超科来灵活的多,不那末拙笨。但尽管如此,比起其他超科来还是和它为近。 我們的王氏鰐和这超科的 Euparkeridae 科很近。阿根廷的 *Saurosuchus* 看来也当属 Ornithosuchidae 科,均归入同一超科。 在孔氏的分类上把 Sceleromochlidae 也归入此超科,而許耐(1962)却把 Sceleromochlidae 提升为超科与其他超科并列。关于此,我們材料有限不必細論。

第三个超科(Chirotheriodea)也很复杂。其中一部分,即为 Aetosauridae, 如瓦尔克所定的。头骨比起其他科来很不相同,前部較尖。前颚骨和下颚骨前部无牙齿或者发育很差。牙齿作木釘状,較为原始。另外一部分为原来許耐所定 Rauisuchidae, 把归于这一科的 *Typothorax* 等属除去,所余的属为代表。主要包括 *Rauisuchus, Prestosuchus, Stagonosuchus* 等属,其特性是牙在上下颚均并未退化, 背脊椎有稜, 全身未为甲板所盖。体格也較大。我們的汾河鰐可以归于这一科。

关于 Elachistosuchoidea 超科,只有一属为其代表,很难提出意見。 另一超科 Sphenosuchoidea 也以一属为代表。但由于构造特别,后者很接近于鰐魚类,所以还是与其他分开为宜。 許耐的 Scleromochlidae, 照孔氏的排法列入鳥鰐超科。但由于很特别,与以后飞龙不无关系,可能应升为一超科,以和其他超科相并立。这末一来,一共六超科,如表 23 所示(頁 190), 同許耐 1962 的比起来,把他的科一律作超科。一、三相并,二分为两科,其他均相当。

把以上关于假鰐类的分类加以回顾之后,我們现在可以討論一下这一亚目演化方面的一些問題。

一般承認,所有后期的初龙类,包括鳥类在內, 都和槽齿类的某些亚目或科有关, 或者說是自他們演化而来的。 在許多情况下, 可以大致不差的指出一些中間的关系。 如認为 *Sphenosuchus* 和以后鰐类有关。 *Sceleromochlus* 和后期的飞龙目甚至鳥类不无联系。 但是关于恐龙各类的祖先問題, 还有些不太清楚的地方。

把图 63 所列的槽齿类在地层上的分布,和后期初龙类的分布加以审視,就可以知道在六个超科中,只有前三超科和恐龙的来源有密切关系。即为 Proterosuchia, Ornithosuchoidea 和 Chirotheriodea。所有三类, 在山西的材料中,都有其代表。

在同一图中,可以看出,蜥龙类和鳥龙类在晚三迭世时已开始出現。所以两类的祖先絕不能在同时期的(即晚三迭世)假鰐类中找。至少关于他們的直系祖先不能这样。但不幸的是,我們关于中三迭世,甚至早三迭世的假鰐类所知太少。因此任何可以指出彼此相互关系的綫索都是值得特別欢迎的。

象在以前所指出的,由于山西山西鰐多一个眼前孔,又具有肉食性的牙齿和头骨的一般构造, 和后期的肉食类恐龙很有些相象,如晚三迭世的 *Teratosaurus* 和侏罗紀白垩紀的一些肉食恐龙等。 眼前多一个孔肯定影响头骨的一般构造,也和生活习性有关,不能低估其意义。

至于头后骨骼都很原始,是典型的四足型的。因此和肉食类相差很远。但是即便如此,山西山西鰐的前肢,也已开始变短(肱骨加橈骨:股骨加脛骨 = 78:85;前肢:后肢 = 71:79)。 此外还有一些很特殊的性质, 如很短的頸脊椎,原始的肩胛骨和腰带骨等,都使我們难以进一步和肉食类恐龙相比較。看来他不可能是肉食类恐龙的直接祖先。但在另外一方面,肉食类恐龙的祖先,应当无疑地在山西山西鰐所属的这一超科中去找。理想的祖先应当是山西山西鰐那样的头骨,再加上进一步发展的四肢骨。我們的山西山西鰐,和这个理想祖先相距不很太远。

上已提过,晚三迭世的鳥鰐为 Ornithosuchoidea 超科的代表,和許多眞正恐龙存在同一时代。 因此它也不可能是和这些恐龙有直接的祖先关系。属于同一超科的中三迭世属新巴氏鰐可能有此种关系, 至少在时

間上不太矛盾。在我們的材料中，認为王氏鳄归于同一超科，而且有些地方可能和新巴氏鳄相比。王氏鳄的四肢骨骨壁很薄，且一般較細小，所以非常可能，归于新巴氏鳄科的王氏鳄，不是不可能和以后的虚骨龙类有一些近的关系。但也有可能这一科只是原鳄超科的另一旁枝，因此就牙齿看，他比任何一超科都較与之为近。这可能帮助說明一些后期的虚骨龙类，也有两个眼前孔。

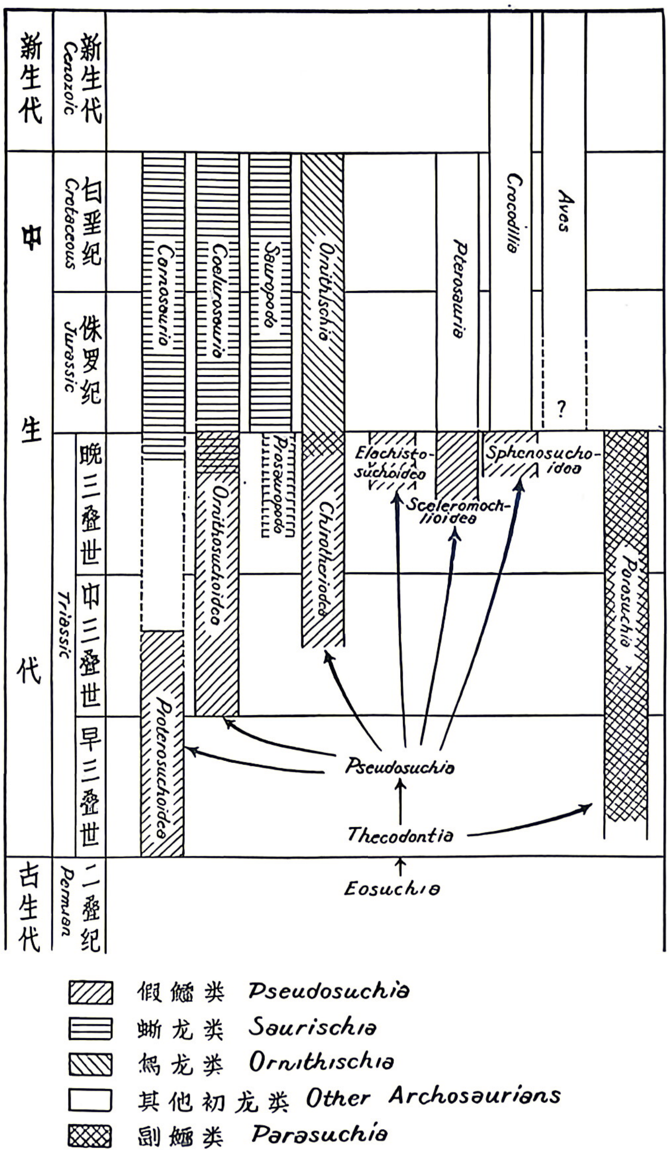


图 63 假鳄类和其他初龙类分类与地层分布图

Fig. 63 Classification and stratigraphical distribution of Thecodontia and other Archosaurians for showing the probable relationship of various groups.

从这两个超科的成員中，推出蜥龙类的原始种类，看来也不太困难。蜥脚类的腰带骨，和这两科的腰带骨，很可以互为比較（特别和头一科比）。只要把恥骨和坐骨加长一些，和把不穿孔的髋臼改为穿孔就行了。以四足行走的方法，甚至，譬如說，和山西山西鳄一样。可以認为四足行走的蜥脚类，可能是从原鳄类分化出来的，这种假設不是不可能的。四足行走的方式为原有性质，而許多种两足化的生活，才是以后发生的性质。长的頸部，也当是后来才获得的一种特殊化。尽管如此推論，蜥脚类可以从两科中任何一科演化而成，但在現有的已知的属中，还沒有任何一种具有无疑的属于它的祖先的性质。可以肯定地講，和其他超科的关系当

然更远。

晚三迭世的原蜥脚类，曾很久被当作蜥脚类的原始类型。但如以上的說法能够成立的話，原蜥脚类只能代表一个旁枝，而不是眞正蜥脚类的祖先，两者的祖先都要在中三迭世，甚或早三迭世的种类中去寻找。

第三超科为 Chirotheriodea，其中第一科包括瓦尔克所列各属，这一科都是具有全身所包的甲板，都是晚三迭世的。另外一科为 Rauisuchidae，为中三迭世，甲板发育不全，但也不是很一般化的种类，在我們中国所发見的汾河鰐，归于这一科。它的頸脊椎較长，背脊椎侧面有稜；四肢骨和甲板都很特殊化，所以也不可能为以后恐龙的直系祖先。但是，鉴于第一科所属的属的上下顎前部牙齿减退或缺失，以及牙齿的叶状构造，的确令人想到可以和鳥龙类恐龙有些关系。这一假定在最近收到的許耐的近作中(Huene, 1962)也予以証实。晚三迭世和早侏罗世鳥龙类的化石极少。但最近发表的异齿龙（*Heterodontosaurus*）(Crompton and Charig, 1962)大大改变了这个形势。这个异齿龙已为眞正的鳥龙类，而 *Aetosaurus* 和 *Stagonolepis* 等也是属于晚三迭世，因此鳥龙类的祖先也是要在更老的中三迭世或早三迭世的地层中去找。可以相信，在这一超科中的希望很大，一定还有待发見的种类。

关于另外三个超科，我們在中国未找見他們的存在。其和后期初龙类的关系表示在图 63 中，只有 Elachistosuchoidea 一超科的地位还不太明了。

图 64，作为图 63 的补充，我們把几个主要假鰐类超科的代表性头骨和以后初龙类的头骨（均不按比尺）按时代表示出来，用以說明其相互的关系。这末一来，非常清楚，槽齿类一目和以后初龙类各目，大多数（如非全部的話）都是平行发展的关系。所有以后初龙类各目，都是独立的目，由槽齿目分化而来。当然，我們的材料，还是不充分，还有些地方留待补充。可是在大体上各类演化的关系，是相当清楚的。

山西假鰐类化石，对于这些問題，总的說来，帮助不多，但也提供了一些有用的綫索，对未来研究也很有用。

## 6. 病态和生态方面的問題

关于汾河鰐的許多骨骼的病态发育，已在前(頁 68) 加以叙述。脊椎骨的不对称的发育，和一些四肢骨关节部分的加粗都非常显著。但是发生病态的原因，还不很清楚。因为有病态骨骼的比例相当之高，所以使我們相信这一动物对那时的环境并不很适合，甚至可以說面临灭亡的命运。也有可能，一些病态的骨骼代表受伤后又恢复的情况。尽管汾河鰐具有一定甲板作为防护，但依然是大的山西山西鰐和同时代生存的其他肉食性动物，如中国顎等侵犯的对象。两种情况，可能都存在。无論如何，对汾河鰐来說，那个时代不是很好过的。因为同时代的肯氏兽几乎沒有可以防护的东西，但发見的病态骨骼非常之少，所以我們相信，前一个原因在解释上更有力一些。

其他种的病态化石，为数很少。但是，如关于山西山西鰐的图 9A；关于黑峪口山西鰐图 39 A；38 A, D 和 41 D, E 以及关于汾河鰐图 46 D 等究竟是病态发育，还是表示这一动物羣中，有其他新种类存在，还是不能十分肯定。

山西山西鰐，和稜脊汾河鰐年輕的个体，包括很幼小的在内，相当之多。照孙艾璘的說法（1963)，56173 地点的楊氏副肯氏兽，也有一些年輕的标本。这个事实説明堆积造成的时候，只經过死亡后短距离的搬运。头骨和四肢骨的部分关节在一起的情况，支持这个說法。

虽然我們在这些含化石层位作了相当多的野外工作，但所得化石种类还是不太多。肯氏兽和假鰐类一般的个体很多。在表 17 中可以看出多数地点种都不到五个，只有三个地点，有五个或五个以上的动物。这三个地点的动物，是分析动物羣的成分和羣落生活习性等的依据。見表 24（頁 193)。

从表 24 可以看出，动物中大多数的种，是杂食性的动物，生活在低的池沼地区和礁湖地区。由山西山西鰐的牙齿看来，这个动物肯定是肉食性的。虽然另外一种，黑峪口山西鰐沒有可靠的牙齿找到，也大概是同一习性。但是他們的头后骨骼都比較拙笨，一定不是怎末活跃的动物，可能和肯氏兽与迷齿类的生活环境一样或差不多。这些动物肯定有足够的隐藏地方，以对肯氏兽和其他动物作有效的攻击，以及逃避其他对之侵犯的别的可能有的敌性动物。

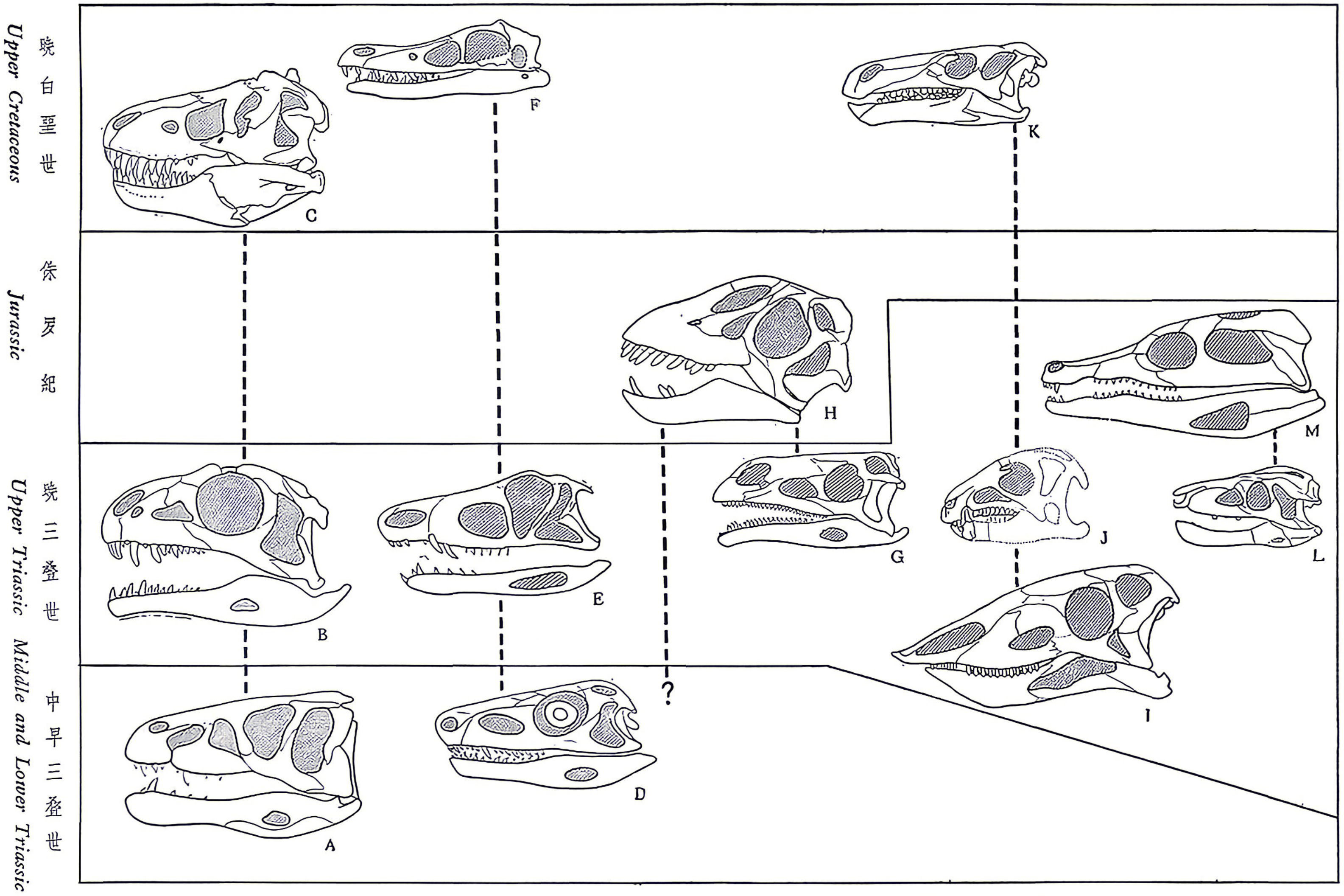


图 64 一些假鳄类与初龙类头骨

用以表示彼此可能存在的相互关系。

Fig. 64 Skulls in side view of various representaives of primitive pseudosuchians and latter archosaurians for showing the possible relationship between them. Note the additional preorbital opening in variuos forms. From left to right: A. *Shansisuchus shansisuchus*, B. *Teratosaurus snevicus*, C. *Tyranosaurus rex*, D. *Euparkeria capenensis*, E. *Ornithosuchus woodwardi*, F. *Velociraptor mongoliensis*, G. *Plateosaurus fracarianus*, H. *Helopus zanskyi*, I. *Stagonolepis robersoni* (after walker), J. *Heterodontosaurus tucki* (after Cromption and Chang), K. *Camptosaurus medius*, L. *Sphenosuchus acutus*, M. *Protosuchus richardsoni* (Brown) (after Colbert.). The dotted lines suggest the relationship between the known pseudosuchians and latter groups of dinosaurs and crocodiles. (All pictures, except A, are adopted from current literature mostly from Huene, Gregory unless otherwise noticed.)

至于王氏鳄和中国颚兽，也都是肉食习性，但比之上两种来，較为活跃。可能不一定和肯氏兽与迷齿类共生，而生活在平原或更高的內陆。这也是为什么这些动物比較少的一个原因。他們之少，不能单純地解释为采集上的疏忽（当然可能也有），因为从56173地点，几乎所有含化石地层全部采掘一光，但王氏鳄还是很少，别的小动物也沒有发見。同其他动物比起来，它們肯定是异乡客。

汾河鳄的生活习性不怎末清楚，沒有的确属于这一种的牙齿。如果以前所述的归于这一种的前上颚骨和下颚是正确的話，其牙齿可能和山西山西鳄相差不多。至少就一些牙槽为椭扁状的孔来看，应当如此。这个动物具有相当发达的甲板，它的生活环境可能和以上其他动物有些不同。很可能和同一超科的 Aetosauridae 和 Rauisuchidae 差不多。

## 7. 假鳄类的来源

假鳄类和副鳄类构成槽齿类目的两个亚目。这是多数作者所公認的。同样一般也都認为槽齿类，乃是由更老的始鳄类（三迭紀）而来。如南非的 *Youngina*, *Youngoides* 等属。但在很大程度上，这还只是假設性的說法。介于二者之間，还有很大的空隙需要填补。最早而原始的 *Proterosuchus*，材料不够完全，而引鳄和加斯馬吐龙，已或多或少有些特殊化。不能对推断假鳄类祖先作出許多帮助。所以在晚二迭世和早三迭世的地层中，还有許多可以希望得到的更原始的种类，为这个問題提供綫索。在目前我們只能満足于一般的說法，認为早期的始鳄类为槽齿类的祖先。照甘頗和其他人的說法，一些属如 *Prolacerta* 和 *Tangasaurus* 都比較接近于鱗龙类，而和我們假鳄类較远。

至于袁氏三台龙，近已由許耐归于前稜蜥一类动物，和初龙类根本无任何关系。

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表 25 本文所用野外地点索引

(Table 25 Index of field localities used in the present memoir)

| 野外号 (Yewaihao) | 地点 (Dì dian) 地名 (Dì míng) | 县名 (xiàn míng) | 外文名称 (Wài wén míng chēng) |
|---|---|---|---|
| 5523 (V.2515) | 北盘顶(石壁西三里) (Běipándǐng (shíbì xī sānlǐ)) | 武乡 (Wǔxiāng) | Peipanting, Shihpi. |
| 5526.1 (V.2498) | 东河村东大南洼 (Dōnghécūn dōng dànánwā) | 武乡 (Wǔxiāng) | Tananwa, S. W. Tunghotsun |
| 5534 (V.2499) | 张村沟北中角沟 (Zhāngcūngōu běi zhōngjiǎogōu) | 武乡 (Wǔxiāng) | Chung-chue-kou N. of Changtsunkou |
| 5535 (V.2500) | 楼则峪北牛口豁 (Lóuzéyù běi niúkǒuhuò) | 武乡 (Wǔxiāng) | Niukouho, N. Lotseyue |
| 5537 (V.2517) | 楼则峪北石片沟 (Lóuzéyù běi shípiàngōu) | 武乡 (Wǔxiāng) | Shihpienkou, N. Lotzeyue |
| 5674 (V.2493) | 銀郊南小土沟 (Yínjiāo nán xiǎotǔgōu) | 榆社 (Yúshè) | Hsiaotukou, Yingchiao |
| 5675 (V.2518) | 銀郊南小土沟 (Yínjiāo nán xiǎotǔgōu) | 榆社 (Yúshè) | Hsiaotukou, S. of Yingchiao |
| 56153 (V.2497) | 斗角沟村东南柴沟 (Dǒujiǎogōucūn dōngnán cháigōu) | 武乡 (Wǔxiāng) | Tsaikou, S. E. Touchuekou |
| 56155 (V.2512) | 刘家山东大南沟 (Liújiāshān dōng dànángōu) | 武乡 (Wǔxiāng) | Tanankou, E. Liuchiashan |
| 56156 (V.2496) | 楼则峪北狼窝沟尖土湾 (Lóuzéyú běi lángwōgōu jiāntǔwān) | 武乡 (Wǔxiāng) | Longwokou, Lotzeyue |
| 56157 (V.2705) | 楼则峪北狼窝沟見赶沟 (Lóuzéyú běi lángwógōu jiàngǎngōu) | 武乡 (Wǔxiāng) | Chienkankou, Langwokou, N. Lotzeyue |
| 56159 (V.2494) | 楼则峪狼窝沟十个洞 (Lóuzéyú lángwōgōu shígèdòng) | 武乡 (Wǔxiāng) | Shihketung, Lotzeyue |
| 56172 (V.2495) | 神西村北二里山家凹 (Shénxīcūn běi èrlǐ shānjiāo) | 武乡 (Wǔxiāng) | Shanchiawa, N. Shensitzun |
| 56173 (V.2514) | 楼则峪北西什凹 (Lóuzéyú běi xīshíāo) | 武乡 (Wǔxiāng) | Hsishihwa, Lotzeyue |
| 60116 (V.2513) | 黑峪口 (Hēiyúkǒu) | 兴县 (Xīngxiàn) | Heiyuekou, N. W. Shansi |
| NWC. E (V.2501) | 二馬营孙家沟 (Èrmǎyíng sūnjiāgōu) | 宁武 (Níngwǔ) | Sunchiakou, Ehrmayin |
| NWC. E. D (V.2502) | 大场虎台沟 (Dàchǎng Hǔtáigōu) | 宁武 (Níngwǔ) | Hutaikou, Tachang |

續 上 表

| 野外号 (Yewaihao) | 地点 (Dì dian) | | 外文名称 (Wài wén míng chēng) |
| --- | --- | --- | --- |
| | 地名 (Dì míng) | 县名 (xiàn míng) | |
| (V.2507) | 欢凹沟 (Huānāogōu) | 静乐 (Jìnglè) | Huanyaokou |
| (V.2695) | 二郎山 (Èrlángshān) | 武乡 (Wǔxiāng) | Ehrlangshan (Exact locality unknown) |
| (V.2698) | 羊圈坡 (Yángquānpō) | 武乡 (Wǔxiāng) | Yangchuanpo (Exact locality unknown) |
| (V.2708) | 小宋沟 (Xiǎosònggōu) | | Hsiaosunkou |
| (V.2709) | 龙土沟 (Lóngtǔgōu) | 武乡 (Wǔxiāng) | Lungtukou |
| (V.2699) | (Exact locality unknown certainly from Wuhsiang) | | |

表 26　本文所用室內登記索引(按地点排列)

(Table 26. Index for catalogue numbers 〈according to localities〉 of the Institute of Vertebrate Palaeontology and Palaeoanthropology)

| 本所登記号 | 野外号 | 地　　点 | 化　石　名　称 | 主要标本 |
|---|---|---|---|---|
| V.2493<br>V.2493A<br>V.2493B | 5674 | 山西榆社銀郊小土沟<br>(Hsiaotukou) | *Shansisuchus shansisuchus*. gen. et sp. nov.<br>*Fenhosuchus cristatus*. gen. et sp. nov.<br>*Shansisuchus heiyuekouensis*. sp. nov. | Ilium<br>Tibia<br>Femur |
| V.2494<br>V.2494A<br>V.2494B | 56159 | 山西武乡楼則峪北狠窝沟<br>十个洞<br>(Shihketung) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Shansisuchus heiyuekouensis*. sp. nov.<br>*Fenhosuchus cristatus* gen. et sp. nov. | Upper and<br>lower jaws<br>teeth<br>vertebrae<br>humerus |
| V.2495 | 56172 | 山西武乡祌北村二里山家凹<br>(Shanchiawa) | *Shansisuchus shansisuchus* gen. et sp. nov. | Pubis<br>tibia |
| V.2496 | 56156 | 山西武乡楼則峪北狠窝沟<br>(Longwokou) | *Shansisuchus heiyuekouensis*. sp. nov. | Femur<br>tibia |
| V.2497 | 56153 | 武乡斗角沟村东南柴沟<br>(Tsaikou) | *Shansisuchus shansisuchus* gen. et sp. nov. | Femur |
| V.2498<br>V.2498A | 5526.1 | 武乡东河村东大南洼<br>(Tananwa) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Shansisuchus heiyuekouensis* sp. nov. | Ilium<br>Scapula |
| V.2499<br>V.2499A | 5534 | 武乡张村沟北中角沟<br>(Chungchuekou) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Fenhosuchus cristatus* gen. et sp. nov. | Vertebrae<br>lower jaw<br>Humerus |
| V.2500<br>V.2707 | 5535 | 武乡楼則峪北牛口憥<br>(Niukouho) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Wangisuchus tzeyii* gen. et sp. nov. | Teeth limbs<br>Calcaneum<br>upper jaw<br>lower jaw<br>vertebrae |
| V.2501<br>V. | NWC. E. | 宁武二馬营孙家沟<br>(Sunchiakou) | *Shansisuchus shansisuchus* gen. et sp. nov. | Skull Ribs<br>fibula<br>vertebrae |
| V.2502<br>V.2502A<br>V.2696 | NWC. E. D. | 宁武大埸虎台沟<br>(Hutaikou) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Fenhosuchus cristatus* gen. et sp. nov.<br>*Shansisuchus heiyuekouensis* sp. nov. | Sacral<br>humerus<br>femur<br>drosal<br>ischium |

續 上 表

| 本所登記号 | 野 外 号 | 地 点 | 化 石 名 称 | 主 要 标 本 |
|---|---|---|---|---|
| V.2512 | 56155 | 武乡刘家山大南沟 (Tanankou) | *Shansisuchus shansisuchus* gen. et sp. nov. | Humerus |
| V.2507 | | 静乐欢凹沟 (Huanyaokou) | *Shansisuchus shansisuchus* gen. et sp. nov. | Femur |
| V.2513<br>V.2513A | 60116 | 山西兴县黑峪口 (Heiyuekou) | *Shansisuchus heiyuekouensis* sp. nov.<br>*Shansisuchus shansisuchus* gen. et sp. nov. | Limba<br>femur |
| V.2514<br>V.2514A<br>V.2697<br>V.2701–2704 | 56173 | 武乡楼则峪西北西什凹 (Hsishihwa) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Shansisuchus heiyuekouensis* sp. nov.<br>*Fenhosuchus cristatus* gen. et sp. nov.<br>*Wangisuchus tzeyii* gen. et sp. nov. | Premaxilla<br>Maxilla<br>predentary<br>mandibula<br>tooth<br>radius<br>scapula<br>ulua<br>femur ilium<br>fibula<br>tibia |
| V.2515<br>V.2516<br>V.2706 | 5523 | 武乡石壁西北盘顶 (Peipanting) | *Shansisuchus shansisuchus* gen. et sp. nov.<br>*Shansisuchus heiyuekouensis* sp. nov.<br>*Wangisuchus tzeyii* gen. et sp. nov. | Limbs<br>ulna<br>vertebrae<br>broken<br>tooth |
| V.2517 | 5537 | 武乡楼则峪北石片沟 (Shihpienkou) | *Shansisuchus heiyuekouensis* sp. nov. | Sacral rib |
| V.2518 | 5675 | 榆社銀郊南小土沟 (Hsiaotukou) | *Shansisuchus heiyuekouensis* sp. nov. | Distal and of a right femur |
| V.2695 | | 二郎山 (Ehrlangshan) | *Shansisuchus heiyuekouensis* sp. nov. | Caudal vertebrae |
| V.2698 | | 武乡(?)羊圈坡 (Yangchuanpo) | *Fenhosuchus cristatus* sp. nov. | Tibia |
| V.2699 | | | *Fenhosuchus cristatus* sp. nov. | vertebra |
| V.2705 | 56157 | 武乡楼则峪北狠窝沟見赶沟 (Chienkankou) | *Wangisuchus tzeyii* gen. et sp. nov. | Vertebrae limb |
| V.2708 | | 小宋沟 (Hsiaosunkou) | *Wangisuchus tzeyii* gen. et sp. nov. | vertebrae |
| V.2709 | | 龙土沟 (Lungtukou) | *Wangisuchus tzeyii* gen. et sp. nov. | Tibia |

**表 27　插图簡字說明**

**(Table 27. Abbreviations for text-figures)**

| | | | |
|---|---|---|---|
| an | angular 隅骨 | par | prearticular 前关节骨 |
| art | articular 关节骨 | pmx | premaxilla (l., left; r., right) 前上颚骨 |
| b | boss 突起 | po | postorbital 眶后骨 |
| bo | basioccipital 基枕骨 | pof | postfrontal 后额骨 |
| bs | basisphenoid 基蝶骨 | prf | prefrontal 前额骨 |
| c | caudal vertebra 尾脊椎 | preo | second preorbital opening 第二眼前孔 |
| co | coracoid 烏喙骨 | pu | pubis 恥骨 |
| cho | choane 內鼻孔 | qu | quadrate 方骨 |
| d | dental 齿骨 | r | rib 肋骨 |
| df | dental formen 齿骨孔 | ra | radius 橈骨 |
| fo | foramen magnum 枕骨孔 | s | scapula 肩胛骨 |
| fr | frontal 额骨 | sa | surangular 上隅骨 |
| il | ilium 腸骨 | sI | supratemporal opening 上颞颥孔 |
| ip | interparietal 間顶骨 | sII | infratemporal opening 下颞颥孔 |
| is | ischium 坐骨 | scI | sacral vertebra I 荐骨脊椎 I |
| l | lacrymal 泪骨 | scII | sacral vertebra II 荐骨脊椎 II |
| op | opisthotic 后耳骨 | so | supraoccipital 上枕骨 |
| mx | maxilla (l., left; r., right) 上颚骨 | sorb | suborbital opening 下眼孔 |
| n | nasal 鼻骨 | spl | splenial 夹骨 |
| no | nasal opening 鼻孔 | t | teeth 牙齿 |
| p | parietal 顶骨 | v | vertebrae 脊椎 |
| pa | parapophysis 椎体突 | | |

**附記**：自本稿付印后，收到克列布斯(1963)发表的关于自瑞士阿尔卑斯山区三迭系阿尼西克层新发现的一大假鰐类足骨的文章。就所附图观察，距骨和跟骨都和我們所描述的不大相同。但有些可能和汾河鰐的相同骨骼在大小和构造上可以比較。在欧洲阿尔卑斯相的三迭系中发見和南非犬齿兽层及其他地区同层可比較的假鰐类是十分重要的。遗憾的是假鰐类的全副骨骼尚未发表，有关資料未能在本研究中充分加以使用。

# 图版及其說明（I—X）

## EXPLANATION OF PLATES（I—X）

图版 I　自 56173 地点的一块标本，表示山西山西鳄遗骨富集之状。原大二分之一。

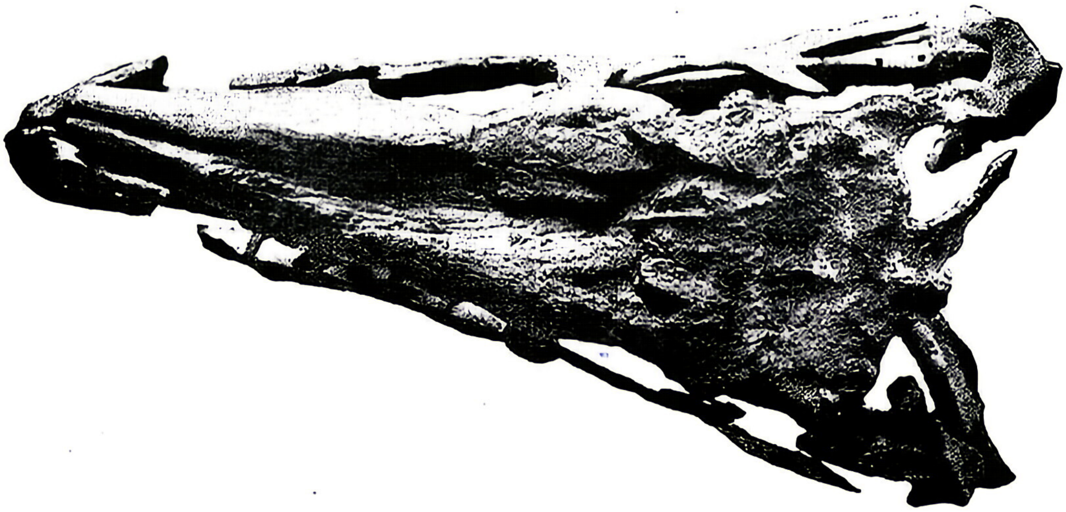
Plate I　A slab with remains of *Shansisuchus shansisuchus*, showing the richness of the bones in locality 56173. Abbreviations of the recognized bones: mx. maxilla left and right; na. nasal; pm. premaxilla left and right; r. radius; t. teeth; v. vertebra. Note the upper process of the maxilla is well shown, better than the other isolated upper jaws. 1/2 nat. size.

图版II 山西山西鳄，新属新种 V. 2503 头骨的综合装架，上视与左视。原大四分之一。

Plate II *Shansisuchus shansisuchus* gen. et sp. nov. The composite skull with lower jaws in dorsal (upper) and left side views (lower). The skull roof is the type (V. 2503). 1/4 nat. size.

图版 III　山西山西鳄，新属新种 V. 2506 头盖骨综合装架，上视与左视。原大四分之一。

Plate III *Shansisuchus shansisuchus*, gen. et sp. The skull roof of V. 2506 mounted with skull elements of 56173 in dorsal (upper) and left side (lower) views. 1/4 nat. size.



图版 IV 山西山西鳄,新属新种 V. 2505 头盖骨装架,上视及左视。原大四分之一。

Plate IV *Shansisuchus shansisuchus*, get. et sp. nov. Composite skull with the skull roof V. 2505 in dorsal (upper) and lefr side views (lower). 1/4 nat. size.

图版 V 山西山西鳄，新属新种 V. 2501 头盖骨综合装架。原大四分之一。

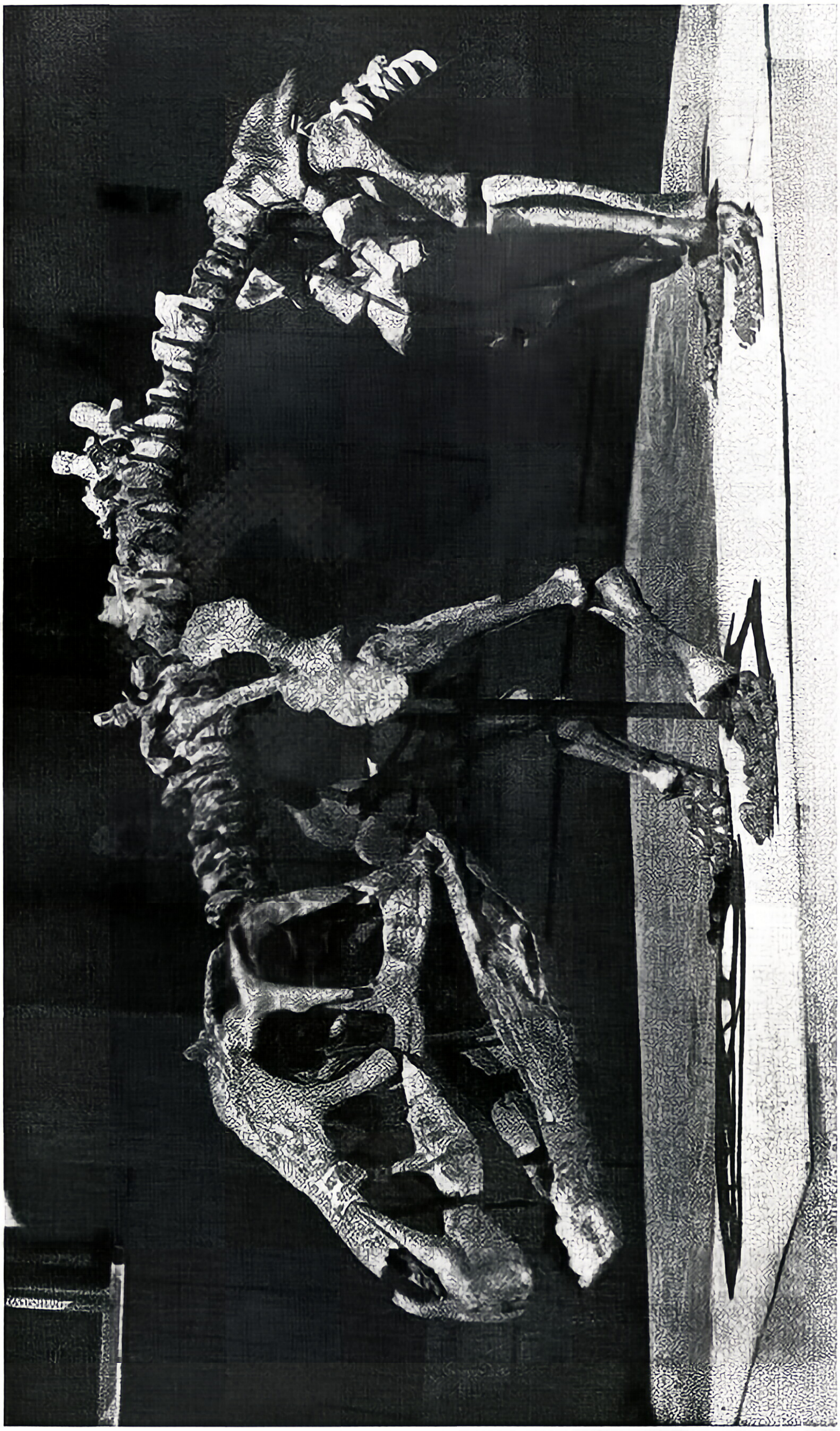
Plate V *Shansisuchus shansisuchus*, gen. et sp. nov. The skull roof and other skull elements from Sunchiakou (V. 2501) mounted with the other part of the skull and lower jaws from 56173 upper figure, dorsal view; lower figure left side views. 1/4 nat. size.

图版 VI 山西山西鳄,新属新种 以 V. 2503为主之全部复原,斜自前左看。由苏有玲、李功卓架置。約原大十分之一。

Plate VI *Shansisuchus shansisuchus*, gen. et sp. nov. A tentative reconstruction of the skeleton, using the skull roof V. 2503 (cf. plate II), obliquely from the left anterior side. It was made mainly by Mr. Y. L. Sou and K. C. Li. The ilium is puted a little bigher and the femur too vertical. About 1/10 nat. size.

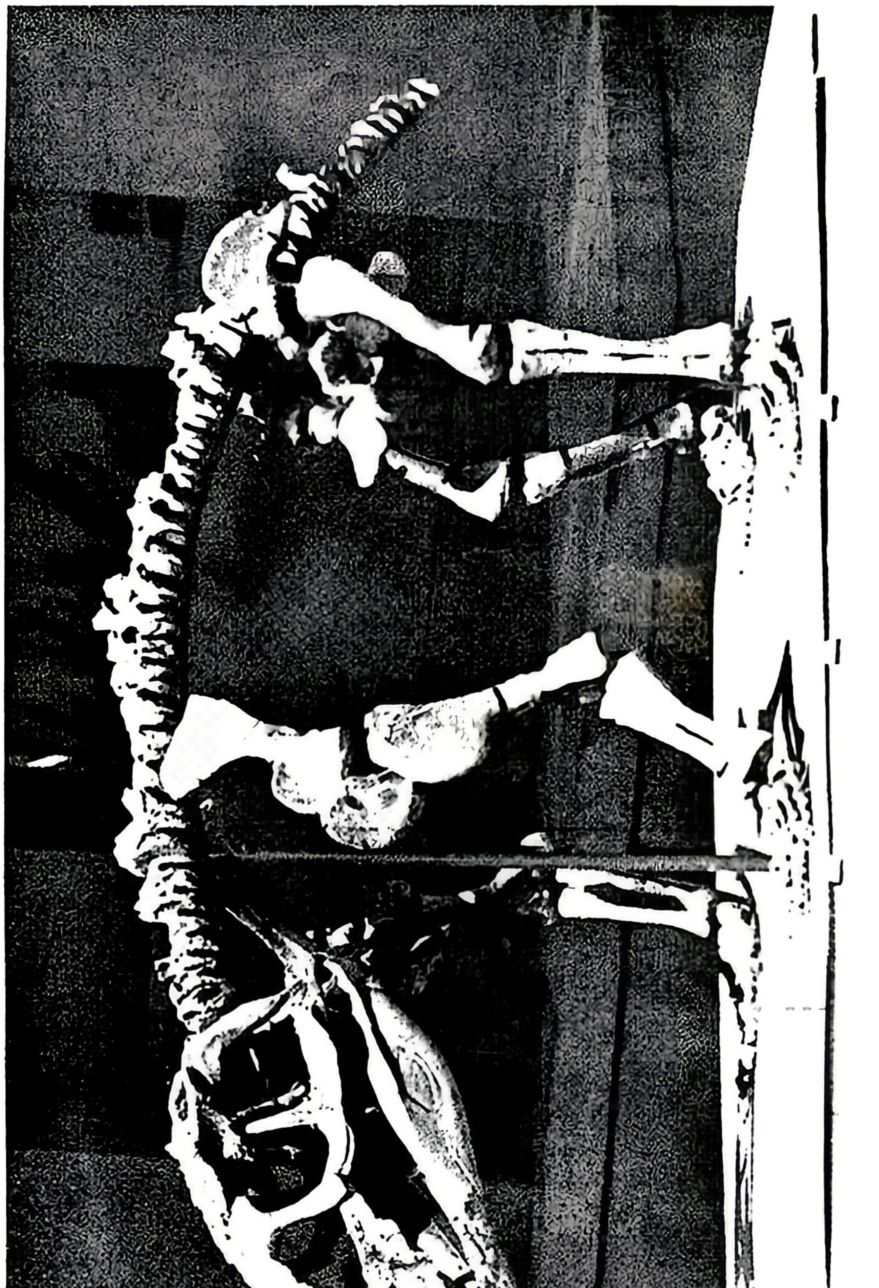
图版 VII 山西山西鳄，新属新种 以 V. 2501 为主之綜合装架，不足之骨采用 56173，看来部較小，腸骨較高。前肢部分由于斜覗，也稍直一些。由苏有玲、李功卓做。在图版 VI—VIII，放弃对缺失脊椎部分，尾后部脊椎和肋骨的复原。約原大十分之一。

Plate VII *Shansisuchus, shansisuchus*, gen. et sp. nov. A. tentative composite recostruction of the skeleton using the skull of V. 2501 (cf. Plate V) and the vertebra and pelvic girdle of the same individual. The other part of the skeleton is completed by the specimens of 56173 which are mostly too small. The ilium is little higher, the posterior limb looks too vertical partly due to the lateral anterior view of the picture. It is mounted by Mr. Y. L. Sou and K. C. Li. No attempt is made for restoration of missing part of the vertebrae, posterior caudal vertebrae and the ribs (same for plate VI plate VIII). 1/10 nat. size.



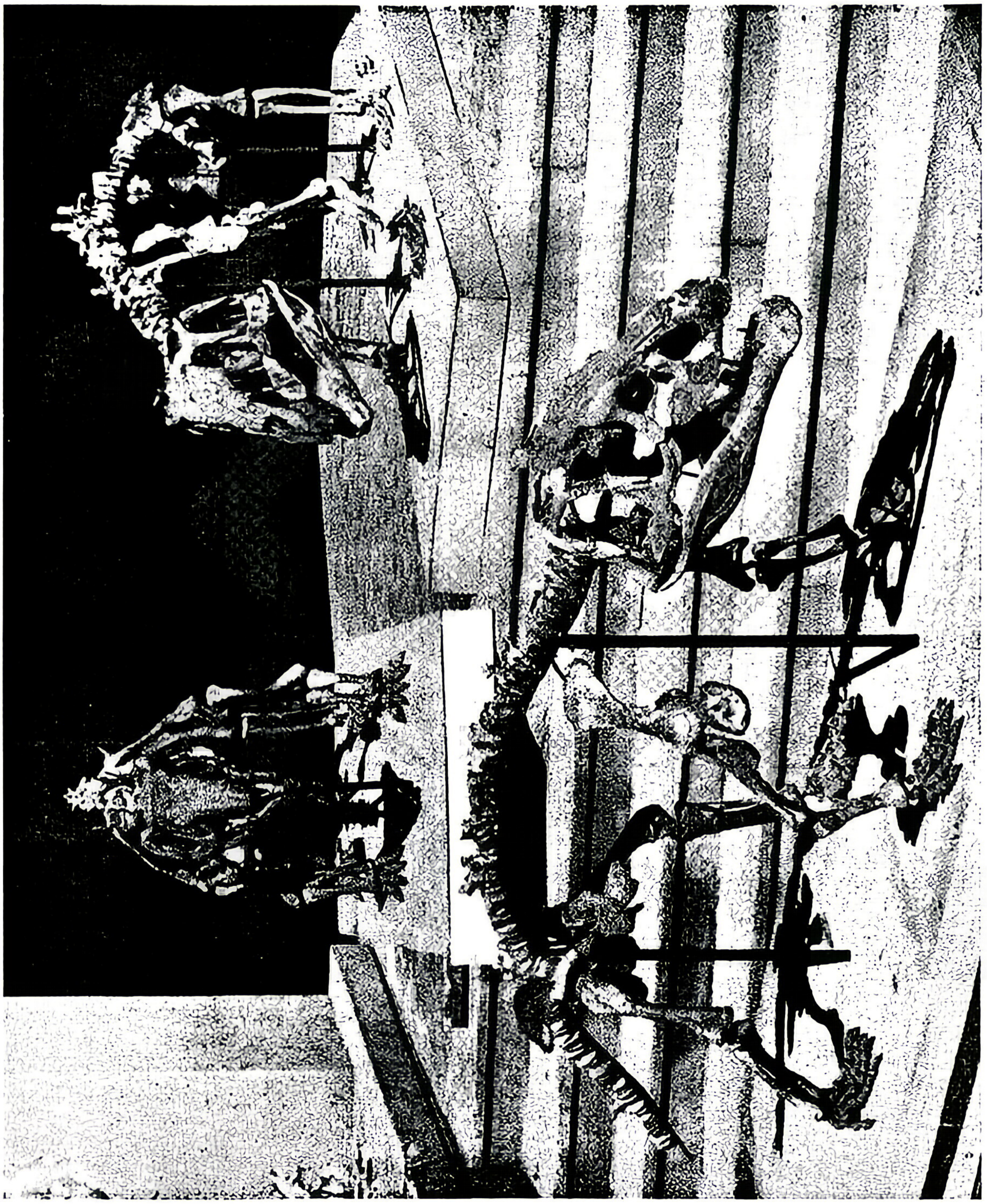
图版 VIII 山西山西鳄，新属新种 由 V. 2506 和 60116（V. 2513）地点及 56173 地点合成之骨架。后者的标本，比較为小。由苏有玲、李功卓做。約原大十分之一。

Plate VIII *Shansisuchus shansisuchus*, gen. et sp. nov. A composite reconstruction of the skeleton with the mounted skull V. 2506 (cf. plate III) and part of the skeleton from 60116. The other specimens of 56173 are used for the completeness of the restoration. They are comparatively some what too small than those of 60116. It is mounted by Mr. Y. L. Sou and K. C. Li. About 1/10 nat. size.



图版 IX 山西山西鳄，新属新种 VI—VIII. 三骨架集体观。V. 2503在前，V. 2506左后，V. 2501右后。

Plate IX *Shansisuchus shansisuchus*, gen. et sp. nov. The entire view of the three mounted composited skeletons, showing in plates VI—VIII: with V. 2503 in fore ground V. 2506 in the back ground left and V. 2501 back ground right in different views. The pelvic girdle is a little higher and should be some what lower in position.



图版 X 山西山西鳄，新属新种 王存义所作之山西山西鳄生活复原想象图。約原大十六分之一。

Plate X *Shansisuchus shansisuchus*, gen. et sp. nov. Restoration of *Shansisuchus shansisuchus* modeled in plastelines by Mr. C. Y. Wang. About 1/16 nat. size.

# PALAEONTOLOGIA SINICA

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# THE PSEUDOSUCHIANS IN CHINA

by

Chung-chien Young

(*Institute of Vertebrate palaeontology and Palaeoanthropology, Academia Sinica*)

With 64 text-figures, I to X plates and 27 lists

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# THE PSEUDOSUCHIANS IN CHINA*

Chung-chien Young

(*Institute of Vertebrate Palaeontology and Palaeoanthropology, Academia Sinica*)

**Abstract**

The present paper deals with the systematic study of the pseudosuchians from Wuhsiang, Yueshe, Ningwu, Chinglo and Shinghsien, collected by the members of the Institute of Vertebrate Palaeontology and Palaeoanthropology during the years 1955, 1956, 1959 and 1960.

Three genera and four species of Pseudosuchians are described, attributing to three super-families of this sub-order. *Shansisuchus shansisuchus* is richly represented, forming the main bulk of the whole material. On account of the presence of two preorbital openings, so different from all other known pseudosuchians, it is suggested to erect a new family for it. A small species probably of the same genus is described as *Shansisuchus heiyuekouensis*.

The third form is a large pseudosuchian with the lateral side of the dorsal vertebrae crested and covered by scutes. It is described as *Fenhosuchus cristatus*. It belongs to the super-family Chirotherioidea.

The fourth form is a small pseudosuchian, also with scutes, belonging to the super-family Ornithosuchoidea *Wangisuchus tzeyii*.

A general review of the so far known pseudosuchians in China is given with the revision of the formerly described *Chasmatosaurus yuani* from Wuhsiang. A new species, *Chasmatosaurus ultimus* is proposed. Thus, there are eight pseudosuchians and one parasuchian known in China under the order Thecodontia.

With the study of the pseudosuchians in the Triassic of Shansi it is possible to make a more reliable and conclusive analysis of the vertebrate-bearing stratigraphy in Shansi.

Comparison and correlation of the pseudosuchians of Shansi and the related fauna of the other parts of the world are given. It is closely related with the *Cynognathus*-zone of S. Africa and Zone VI to the base of Zone VII of the U. S. S. R.

The classification of thecodonts, chiefly pseudosuchians is discussed. The pathological and ecological observations as well as the origin of the thecodonts are summarized. The relationship between the early pseudosuchians and the later archosaurian orders are suggested.

## INTRODUCTION

During the field seasons of 1955 and 1956 and later in 1959 and 1960 a great amount of vertebrate remains have been excavated from Wuhsiang and Yueshe of S E Shansi and Ningwu, Chinglo and Shinghsien of N W Shansi. A great part of the fossils including some of general interest were already studied and published (Young, 1957, 1957a, 1957b; 1958; 1959, 1959a, 1959b; Young, Sun, Yeh and Hu, 1959; Young, Sun and Wang, 1959; Sun, 1959, 1963; Yeh, 1958), Sun has published a comprehensive memoir on the entire collection of Kannemeyeridae, which includes a considerable part of the materials of these regions. The present memoir is dealing with all the pseudosuchians discovered from Wuhsiang, Ningwu and Shinghsien etc. commonly in association with the remains of kannemeyerids.

The main bulk of the material was derived from the locality Hsishihwa N W of the village Lotzeyue (field number 56173). From this locality, we obtained not only a very rich accumulation of bones, but also rich in species. Most of them are those of *Shansisuchus shansisuchus*. As shown in Tab. 1 there are more than thirty-three individuals of *Shansisuchus shansisuchus* represented by the mostly abundantly preserved femora. But in the localities other than this site mainly from some districts of Wuhsiang and a few from Yueshe there are at least 9 individuals represented mostly by fragmentary specimens. In addi-

* Manuscipt ready for publication July 2, 1963.

tion at least four localities with four individuals, also fragmentary, have been found from Ningwu, N W Shansi; and one locality with one individual from Shinghsien. It is thus obvious that we have to deal with so far the richest collection of the single species of a large pseudosuchian.

Besides Kannemeyrids found in association there are poor traces of the presence of capitosaurids in the locality 56173 and some other localities, and at least three forms of other pseudosuchian from various localities waiting for study. With the exception of the capitosaurids which will be described separately, all the other remains of Pseudosuchians are treated here in this monograph[1].

Although the material at my disposal is extraordinarily rich, it is impossible to avoid some difficulties which are almost impossible to overcome. First, as shown below the materials were found in most amazingly confused condition. Only a few isolated bones or specimens can surely be considered as belonging to the same individual. All the reconstructed skeletons are of course of composite nature and thus rather subjective. Secondly, the specimens described or non-described of the related forms abroad are mostly impossible to use. I have been forced to restrict myself to work only with the rather scant literature of this group of animal.

Nevertheless, since the materials are very rich with the most characteristics indicated, it is possible to get fairly reliable and sometimes conclusive results.

In the following pages the general survey of the materials will be given first. The main part of the content is, of course, the full description of the material disregarding their localities. A conclusive part is given at last both stratigraphically and biologically.

The preparation work of the Wuhsiang-Ningwu collection is undoubtedly a difficult task. From 56173 alone tons of hard material with the bones sometimes softer than the matrix have to be worked out carefully. It is difficult to avoid some serious damage and confusion of the field remarks. This work has been done in the laboratory of the Institute. All the material have been prepared by our technicians under Mr. T. C. Chen chiefly during 1957—1959. The restoration model of *Shansisuchus shansisuchus* has been made by our artist Mr. C. Y. Wang under my direction. The mounting of the skeletons were made by Messrs. Y. L. Sou and K. C. Li. The photos and the drawings were made by our artists Mr. C. F. Wang and Mrs. W. C. Hu-Chen. Mrs. Y. Wang-Liu has helped me in many ways during the preparation of the manuscript. I have to extend my cordial thanks to all of them for their labourious work and help.

To Professor F. v. Huene at Tübingen, Dr. B. Hughes of Ghana and Dr. S. P. Welles at Berkeley, the writer is deeply indebted for their kindness either in sending the necessary literatures or suggestions.

# GENERAL CONSIDERATIONS

## 1. Materials at disposal

### A. Collection of Hsishihwa Lotzeyue, Wuhsiang (Field number 56173)

This site was discovered in 1956 by a field party of our Institute. All the fossils were collected from a lens or pocket-like deposits in the strata made of pale white to purplish fine sandstone and mudstone. The main fossiliferous layer is made of such rocks especially rich in concretions. More than two tons of rocks with rich remains of fossils have been removed from this single site. The bones are so rich that we may call the whole rock as bone breccia (PL. I). With the exception of a few blocks which are

1) The result of this study is already published since this paper is sent to press (See Young, C. C., 1963: Note on the Labyrinthodonts of the Sinokannemeyeria fauna in Shansi, Vert. Pala., 7(4), 331—341.

purposely kept for specimens of the museum, all the materials have been prepared. Owing to the disordered condition of the matrix and the highly scattered nature of the bones, it is almost impossible to assert even a single skeleton which is sure of belonging to the same individual. The following list of material includes nearly all the specimens prepared and the smaller blocks with the determinable bones of *Shansisuchus shansisuchus* only:

**Table 1. Materials of *Shansisuchus shansisuchus* from the locality Hsishihwa Lotzeyue, Wuhsiang**

**(Field number 56173)**

| Part of bones | Number | Condition of preservation | Remarks |
|---|---|---|---|
| *Skull*:<br>Skull part with parietals and frontals with or without adjacent bones | 10 | Mostly well preserved with the nasals nearly complete | |
| Isolated skull roof of the frontal part | 12 | Mostly fragmentary | |
| Occipital part | 16 | Mostly fragmentary | |
| Parietal part or the posterior process of the same. | 10 | Mostly the posterior process only | One pair belongs probably to the same individual. |
| Isolated postfrontals | 3 | One of the left side is complete | |
| Isolated prefrontals | 5 | Poorly Preserved | |
| Nasals | 14 | 2 nearly complete of both sides 12 left and 5 right ones and many fragments of the same | |
| Premaxillaries | 17 left, 17 right | Mostly incomplete, some with teeth | Only one pair belongs to the same individual, others doubtful |
| Maxillaries | 23 left, 23 right, 10 fragments and many fragments | Mostly incomplete | |
| Jugal | 2 left, 3 right, 4 fragments | Mostly incomplete | |
| Quadratojugal | 7 left, 7 right, some fragments | Incomplete | |
| Quadrate | 5 left, 11 right, many fragments | Mostly incomplete | A left one is in assosiation with left lower jaw |
| Squamosal | 10 left, 10 right, many fragments | Only a few with the lower process partly preserved | |
| Lacrymal | ?3 | One sticks to the skull roof | |
| Pterygoid | 2 right | Incomplete | |
| Palatine | 3 | | |
| Opisthoticum | 8 | | |
| Anterior part of basisphenoid | 2 | | |
| *Lower jaw*:<br>Articular and prearticular etc. | 3 left, 2 right | Some fragments | |
| Anterior and middle parts of lower jaw | 29 left, 19 right | Mostly anterior ends, some with teeth | Only one with posterior part of the jaw without articular end |
| Isolated angular | 5 left, 7 right | Fragmentary | |
| Isolated teeth | Ca. 133 upper and lower teeth | Only a few attached together | |

| | | | |
|---|---|---|---|
| *Vertebrae*: Atlas | 4 | All isolatedly found | |
| Epistropheus | 1 | | |
| Presacral vertebrae | Ca. 220 | Nearly all in isolated condition and without neural spine and diapophisis | Many isolated spines and diapophysi |
| Sacrum | 15 | Incomplete | I and II altogether |
| Postsacral vertebrae | Ca. 45 | Mostly centrums only | Many isolated spines etc. |
| Ribs | Many with a few complete | Fragmentary | |
| Sacral rib I Sacral rib II | 12 left, 10 right. 5 | Many fragments | |
| Pectoral girdle and anterior limbs: Scapula | 16 left, 14 right, at least 61 middle and distal parts | Mostly incomplete | |
| Coracoid | 10 left, 9 right, 12 incomplete ones | | |
| Interclavicular | 2 | Incomplete | |
| Humerus | 12 left and 12 right, many incomplete ones | About half complete | |
| Radius | 3 left and 4 right | Many broken proximal and distal ends | |
| Ulna | One left incomplete 4 right complete | Many prox. and distal ends | |
| Pelvic girdle and posterior limbs: Ilium | 8 left, 17 right, some fragmentary ends | Mostly incomplete especially the upper border | |
| Pubis | 8 left, 4 right, some fragments | A few ones complete | |
| Ischoum | 14 left, 5 right | Only a few complete | |
| Femur | 5 left, 5 right, 28 proximal ends, 26 distal ends, (left); 11 proximal ends, 13 distal ends, (right). | Complete Incomplete | 33 left, 17 right |
| Tibia | 1 left, 7 right, many broken proximal and distal ends. | Complete Fragmentary | |
| Fibula | 4 left and 3 right many proximal and distal ends | Complete | |
| Hand and foot bones | Very rare. A few metacarpus, metatarsus and phalanges | | |

Ca. 33 individuals

From the enumeration of the material of *Shansisuchus shansisuchus* of the locality 56173 made above, we tentatively estimate that there are about thirty three individuals of this large pseudosuchian represented in this single locality. There are thirty three left femurs and most of the skull roofs, isolated frontals and nasals belong not to the same individual, so that the actual number may exceed this estimation.

Other fossils found in association with this large pseudosuchian are comparatively rare and rather poorly preserved. They are: A capitosaurid, a Kannemeyerid *Parakannemeyeria youngi* and three Pseudosuchians. The remains of the last named materials are described in the same memoir as *Shansisuchus heiyuekouensis, Fenhosuchus cristatus* and *Wangisuchus tzeyii*. The material of each form is listed in the descrip-

tion separately. The kannemeyerid has been described by Sun (1963) and only the capitosaurs will be studied later. (See foot note p. 110)

## B. Material from various localities of Wuhsiang and Yueshe other than 56173

In the Wuhsiang Yueshe area there are ten localities with remains of *Shansisuchus shansisuchus*. Since in no place a large-scale excavation has been made, all fossils are very fragmentary, some of them being only surface collection. It is however worthwhile to note them in order to show the distribution of the present described form. In many of these localities Kannemeyerids are commonly found together (See conclusion, Table 17, p. 183).

**Table 2. Localities of *Shansisuchus* other than 56173***

| Field and cat. number | Name of the locality | Main fossils | Remarks |
|---|---|---|---|
| 5526. 1 V. 2498 | Tananwa, S W Tungho tsun | Ilium | 1 individual |
| 5523 V. 2515 | Peipanching Shihpi | Premaxillae, lower jaws, vertebrae, humerus (fragmentary) | 1 individual |
| 5534 V. 2499 | Chung-Chue-kou N. of Changtsun-kou | Vertebrae (sacrals), lower jaw, femur (fragmentary) | 1 individual |
| 5535 V. 2500 | Niukouyue N. of Lotseyue | Isolated teeth, vertebrae, upper jaw, lower jaw and limbs calcaneums (fragmentary) | 2 individuals |
| 5674 V. 2493 | Hsiaotukou, Ningchiao Yueshe | Ilium, femur tibia etc. (fragmentary) | Surface collection |
| 56153 V. 2497 | Tsaikou, S E Touchuekou | One femur (prox. part) | 1 individual |
| 56155 V. 2512 | Tanankou E. of Liuchiashan | Atlas humerus and claw | 1 individual very large |
| 56159 V. 2494 | Shihketung, Lotzeyue | Nasal, Upper and lower jaws and teeth. some consecutive vertebrae fragmentary limb-bones | 1 individual at least |
| 56172 V. 2495 | Shanchiawa, N. Shensitzun | Ribs and pubis (fragmentary) | 1 individual |

Ca. 9 individuals.

* With the exception of V. 2493 which is located at yueshe, all the other localities belong exclusively to Wushiang.

## C. Material from Ningwu, Chinglo and Shinghsien, N. W. Shansi

Besides the localities of Wuhsiang and Yueshe as listed above, remains of *Shansisuchus* have been found also in N W of Shansi and Shansi-Shensi border. Up to the present, only the three localities of which two were discovered in 1959 form Ningwu and one from Chinglo during the Field Conference of Stratigraphy 1959 and one locality at Shinghsien was discovered in 1960. They are given below:

**Table 3. Localities of *Shansisuchus* of Ningwuhsien, Chinglo and Shinghsien, N. W. Shansi**

| Field and cat. number | Name of the locality | Main fossils | Remarks |
|---|---|---|---|
| NWC, E. V. 2501 | Sunchiakou, Ehrmayin Ningwu | Skull with occipital region, squamosal, quadrate, upper tip of quadratojugal left nasal dorsal vertebrae, ribs left humerus nearly complete pelvic girdle and a fibula | Apparently represents one old individual |
| NWC, E. D. V. 2502 | Hutaikou, Tachang | Dorsal vertebrae and sacral vertebrae and limb bones (fragmentary) | 2 individuals |
| V. 2507 | Kuanwukou, Chinglo | Left femur (distal end) | |
| 60116 V. 2513 | Heiyukou, Shinghsien | Maxilla, 1 anterior anterior vertebrae 5 posterior dorsal vertebrae, first sacral vertebrae, first right sacral rib humerus, femur, and lower anterior and posterior limbs | Partly complete. A number of vertebrae and limbs. A smaller form to be described separately |

Ca. 5. individuals.

Although we have very rich collection of this new pseudosuchian, only that marked as NWC,E. (V.2501) represents one individual without reasonable doubt. As stated above, all the specimens of the locality 56173 are so disordered that it is impossible to be sure of even one skeleton which is definitely belonging to the same individual. Therefore the reconstructed skeletons shown below are conjecture.

On the other, the whole collection contains specimens of a series of representatives from very young to old age and individual variations. It is therefore possible to study more accurately about the features of various parts of the skeleton. The other Pseudosuchians are also very interesting both zoologically and geologically.

For the material from localities other than 56173 of *Shansisuchus heiyuekouensis, Fenhosuchus cristatus* and *Wangisuchus tzeyii* see the description of each form.

## 2. Remarks on stratigraphy

Before the extensive field work made in Wuhsiang and Ningwu etc., the Permo-Triassic Beds are generally known as Shihtienfeng Series and Yenchang Series. In my first study on the dycinodonts found from Wuhsiang and Yueshe, no attempt was made about the precise correlation of the stratigraphy but pointed out the age of the *Sinokannemeyeria*-bearing beds is of Upper Triassic based on the older classification of the Triassic (Broom 1932) and that the *Cynognathus*-zone as Upper Triassic, excluding the real Rhaetic Beds as true Upper Triassic. Subsequently, most of the authors consider the *Cynognathus*-zone as middle or even upper part of Lower Triassic so the *Sinokannemeyeria* beds have to be shifted accordingly, since the fauna of Shansi fits so well with that of S. Africa and at least a general correlation is doubtless.

The recent studies made in Shansi both zoologically and stratigraphically affirm the view that the Kannemeyerids and Pseudouchids-bearing Bone Beds of either Wuhsiang or other parts of Shansi belong neither to the older Shihtienfeng Series nor to the younger Yenchang Series. The new name Ehrmaying series is thus proposed. In the Wuhsiang area where most of the remains of the presently studied fossils were derived, the whole series is about 150 meter thick with at least five horizons with determinable vertebrate fossils (Young 1959; Sun 1963 etc.). All the remains of the described pseudosuchian here belong to the middle part of the series. The stratigraphical distribution of it together with its associate forms will be given at the conclusive part of the paper (Table 17, p. 183). Here it is suffice to point out that there is no indication to divide the *Shansisuchus* and other pseudosuchians-bearing level into more than one horizon as for instance the Kannemeyeridae.

Zoologically speaking all the present described fossils of the form of the large pseudosuchian *Shansisuchus shansisuchus* belong certainly to a single well defined species, although the range of individual variability is very great. In view that the geographical distribution of this form is rather wide, only next to Kannemeyerids, so far, it represents the best fossil in correlating the Red Beds. The other pseudosuchians are also very interesting both zoologically and geologically.

## 3. Procedure of study

Originally, it was planned to study the remains of *Shansisuchus shansisuchus* from the locality 56173 and some other localities besides the kannemeyerids. But during the general survey of the material, three more pseudosuchians were recognized. They are so interesting, that it is decided to study the pseudosuchians of Shansi as a whole, in order to get an entire view of this important group. The pseudosuchian fauna of Shansi comprises three genera with four species all new, belonging to three different super-families. The formerly described *Chasmatosaurus yuani* is revised as a new species.

Since the literatures regarding present study are very scant, I shall try to restrict myself mainly to the description of various bones and to compare them with those whatsoever available, especially the post-cranial bones. Neglecting of a few non-available literatures is not avoidable.

In the study of the present material at disposal it is reported that a few some other localities yield also similar fossils. They are included in the present paper. It indicates that the geographical distribution of the fauna is much wider than we have supposed.

All the tables are included in the English text while the text-figures in the Chinese text both with the necessary translations.

# DESCRIPTION OF THE FAUNA

## Order Thecodontia Owen 1859

### Sub-order Pseudosuchia Zittel 1889

#### Super-family Proterosuchia Broom 1911

#### Family Shansisuchidae fam. nov.

With diagnosis of *Shansisuchus* as the type of the new family.

### Genus *Shansisuchus* gen. nov.

**Diagnosis.** Rather large Proterosuchia very similar in general features to the family Erythrosuchidae of the super-family Proterosuchia represented by the single member *Erythrosuchus,* but differing from it by the presence of two preorbital vacuities and the absence of parietal foramen. The anterior preorbital vacuity extends anteriorly partly below the nasal opening which is terminally situated. Teeth sub-thecodont. Lower jaw with distinct terminal thickening. Lateral opening present in lower jaw. No trace of the presence of intercentrum in post epistropheus vertebrae. Limbs comparatively slenderly built.

#### *Shansisuchus shansisuchus* sp. nov.*

**Material.** As noted above, the material at the writer's disposal is very extensive and rich. Although the skull from Ningwu (V.2501) was found with sure association of some vertebrae and limbs it seems more founded to use the best preserved skull roof V.2503 from the locality 56173 as the real type, since over ninety percent of the material was derived from this locality. The skull with the post cranial bone and the other better preserved skulls from 56173 such as V.2504 to 2511[1)] and the mostly fragmentary specimens from other localities of Wuhsiang and Yueshe area other than locality 56173 and Ningwu and Shinghsien (V.2493, V.2512, V.2450, V.2502, V.2513) are considered as paratypies and refferd specimens respectively. The following description includes all the specimens listed above.

**Horizon and locality.** Upper part of lower Triassic, Hsishihwa, Lotzeyue, Wuhsiang (56173), Shansi and other localities (see Tables 1 to 3, p. 111, 113).

**Diagnosis.** Size smaller than *Erythrosuchus,* but still rather big beast. Skull long stretched. Supra-temporal opening small and directs upwards. Lower temporal opening large, bigger than the orbit and with rounded quadratic outline. The middle process of the premaxilla long, separating the small nasal opening from the second preorbital opening. The upper process of the maxilla situated backwards and more or less convex in lingual side and flat in labial side. Its lower border weakly convex. Jugal rather thin. Nasal

* This name was first appeared in 1959 (Young, 1959B) without giving the diagnosis.

1) The less important specimens are not catalogued.

long and narrow in zigzag connection with the frontals. Nasal opening very small and terminally situated. It is smaller than the second preorbital opening which is smaller than the first one. The anterior part of the second preorbital opening lies below the nasal opening. Orbit large rounded in outline and directs laterally. No parietal foramen but with a boss in position. The frontal takes no part in making the orbit border. Interparietal present with a posterior process. Postfrontal smaller than prefrontal and in articulated connection with the postorbital. A prominent process below the interparietal. Foramen magnum small, broad and low. Lower jaw robust with thickened symphysis and large dental foramen. Teeth sub-thecodont, sharply compressed with anterior and posterior serrations and isodont. Number of teeth probably upper 14, lower 14—16. Number of vertebrae: Neck, 10; dorsal, 15; sacral, 2 and caudal, 40+. All weakly amphicoelous. Neck vertebrae short, anterior dorsal robust and posterior dorsal small and elongated. Sacral I much larger than II with ventral groove. Centrum of caudal more constricted. No trace of intercentrum except the atlas. Scapula more constricted at the middle, distal expanded. Coracoid robust and triangular with coracoid foramen rather marginal. Humerus extremely expanded at both ends without entepicondyloid foramen. Ulna short, slightly longer than radius. Acetabulum probably not entirely closed. Ilium Plate thin with the anterior extension weak and obtuse and the posterior rod-like thickening. Ischium similar to *Erythrosuchus*. Pubes foramen marginal with notch. Femur straight. Tibia and fibula comparatively slender. The posterior limb distinctly longer than anterior. Astragalus large. Calcaneum plate shaped. Matacarpals and metatarsals and the phalanges short and the terminal Phalanx compressed and sharply pointed. Certainly plantigrade.

## Description of the type skull and other skull roofs

**The type skull.** (V.2503) This is the most well preserved skull roof in the locality 56173 and represents a mature individual. It contains the part from the tip of the nasal (slightly damaged) to the posterior processes of the parietals. Although the marginal and tip parts of various bones are somewhat damaged such as the tip of nasals and the posterior processes of the parietals and the right side of the pre- and the post-frontal, the skull shows the remarkably well preserved bones from the nasals to the parietals including frontals and pre- and post-frontals with mostly well preserved sutures.

The ventral part and both lateral aspects are poorly preserved and some undeterminable bones sticking to the matrix, but the lateral views of both anterior parts of nasals are well indicated.

The skull roof is much longer stretched and looks slender. The anterior median sutures, especially that of the nasal are loosely in contact, showing that the specimen is just above the maturity. The total preserved length from the tip of the nasals to posterior tip of the interparietal is 420 mm and the real length may be estimated about 440 mm. The length of the nasal is distinctly longer than the remaining length of the skull. The maximum width of the skull lies before the orbit at the sides of the prefrontal.

There is no sure separation between the interparietal and the parietal. It is not considered as a separate bone but only as the median posterior point by v. Huene in his description of *Eury throsuchus africanus* Broom (Huene, 1911) but as the real interparietal by Brink in his description on the specimen of the same species of the National Museum, Bloemfontein, no, 2663 (Brink, 1955). It seems to the writer that the interparietal is really present as that of *Chasmatosaurus,* because the posterior of the posterior overhanging transversal ridge of the parietals and between the two divergent processes of the same there is faint indication of suture as given in figure 1. The posterior tip of the present specimen is damaged but is clearly indicated in other skull, V.2505, V.2501, which is subrounded (Fig. 1, p. 6).

**Parietal.** There is no parietal foramen but there is a distinct boss at the very place. The median

suture between the parietals lies at the middle part of the boss. The parietals are short and broad. The median border of both supratemporal openings are well preserved. At the posterior border of the parietals develops a more or less distinct overhanging ridge which extends laterally and posteriorly along the upper border of the posterior processes.

**Frontals.** The median posterior part of both frontals is somewhat depressed while the lateral part is clearly ridged. Due to the direct contact between the pre- and post-frontal (clearly shown at the left side and broken at the right side) the frontal is certainly excluded from the border of the orbit. In all parts the sutures are clearly traceable and the same of the anterior median part lies rather apart from each other. The connection of the frontal and prefrontal with the nasals is remarkally zigzag as in the case of *Erythrosuchus* but the lateral anteriorly extended process of the frontal is very short.

**Postfrontal.** As in *Erythrosuchus* and *Chasmatosaurus* and less clear or absent in *Vjushkovia* (Huene, 1960) and *Garjainia* (Orchev, 1958), this bone is clearly present and well separated from the other adjacent bones. In the type specimen the lateral border of both is damaged but their outline is clearly shown in the figure 1. It is a long and narrow bone much smaller than the prefrontal.

**Prefrontal.** The left one is better preserved with only part of the lateral border missing. Its greatest breadth lies at anterior border of the orbital opening and a distance before the constriction above the orbit. Then it narrows gradually anteriorly with a pointed tip inserting to the nasal somewhat medially to the lateral border. In this part the bone is slightly elevated above the level of the frontal.

**Nasal.** The nasals are nearly complete, only the anterior tip and the posterior lateral border of the right side are damaged. The constriction behind the posterior part of the second anteorbital opening is only weakly indicated in the present specimen. The contact of both is not made of zigzag suture as in other bones but in straight line which is posthumously apart from each other. The place for the insertion of the posterior process of the premaxilla separating the posterior border of the nasal from the second anteorbital opening as well as part of the border of the latter is clearly indicated on both sides. In side view, the posterior part of the nasal and the second anteorbital is for considerable portion visible. The downward extension of the nasal bordering the posterior and the lower part of the second anteorbital opening is conspicuous.

The other better preserved skull roofs supplement considerably the type specimen.

**Skull roof V.2506 from 56173.** This specimen shows the posterior part of skull roof with only the posterior part of the nasals preserved. The nasals are rather displaced from the remaining skull. But it is the only specimen in our collection with both postorbitals in original position. Even the anterior and downward process of the postorbital is preserved. In this case we can get a fairly clear idea about the shape and outline of the supratemporal and orbital openings (Fig. 2, A, p. 7).

In this specimen the outline and suture of the interparietals are better indicated than those of the type, the posterior prolongation of which is likewise broken away, the distal end of both the posterior processes of the parietals are broken. It differs from the proceeding specimen by the more distinct small elevated thickening formed at the lower part near the base. In the type it is only scarcely indicated. Between the pre- and post-frontal the sharp constriction of the skull is well shown, yet it is about 10 mm separated from the frontal. At the left side the suture-like line between the real contact of the prefrontal and postfrontal which lying at the constricted point is apparently a fracture. Both bones are formed in the same way as those of the type. There is little to be said about the nasal. The downward extension behind the second anteorbital opening is partly preserved at the left side. The zigzag interlocking with the frontal and prefrontal must be the same as that of the type, although it is a little displaced.

**Postorbitals.** In this specimen both the postorbitals are intact, only the posterior process of both is broken away and the tip of the lower process of the left side is incomplete. This is a bone radiating to three sides and forming the separation between the supra and lower temporal openings and supratemporal and orbital opening as well as lower temporal and orbital openings. The contact line with postfrontal is almost straight and about 45 degrees to the longitudinal axis of the skull. It may be movable when alive. The part between the supratemporal and orbital openings are broad and with a distinct depression. From there the bone narrows and directs laterally posteriorly forming the lateral border of the supratemporal opening. A depression is also observable at the part about the middle of the bar. The lower process extends anteriorly and downwards. Short below the upper border of the orbit it expands anteriorly and then narrows gradually, a part in contact with the upper process of the jugal.

**The skull roof V.2505 from 56173.** This is a rather young skull and preserved about the same condition as the type. However, the terminal part of the nasal and the part of the interparietal is better preserved. Owing to the younger age, the irregular grooves (mainly in longitudinal direction) and the ruggedness of the surface of the bone are much better expressed. Comparing with the type, the constriction at middle part of the nasals just behind the downward extension is more distinct. At the jointed part of the nasals and the frontals there are three deep depressions, as if they were formed by wound (Fig. 3, p. 8).

More interesting is the ventral view of the skull roof which is entirely exposed. In general the structure agrees well with that of *Erythrosuchus* given by Brink 1955. In our form the sharp transversal ridge separating the brain case and interparietal and the posterior process of the parietal is prominent. The depressed area is well formed as the ventral side of the boss of the dorsal view. There is no trace of the parietal foramen as is in *Erythrosuchus africanus* given by v. Huene. At each side there develops a triangular depressed area in contrast to the elevated part of the posterior region of the frontals. In the front of that part three radiated depressions are formed, separated by rather sharp ridges. The lower process of the left prefrontal is partly preserved. In the nasal area the bone is marked by two longitudinal ridges more distinct posteriorly and less so anteriorly.

**Skull roof V.2504 from 56173.** This is a less well preserved specimen, especially the nasal part. The root of the postorbitals is partly preserved, more so at the left side. It is apparently a mature individual, may be more aged than the type. The posterior end of the interparietal is missing. The ventral side of the roof is also exposed but not so well as that of V.2505. The structure of it agrees in all details with the above mentioned specimen (Fig. 4, A, p. 9).

**Skull roof V.2508 from 56173.** It is not absolutely sure that the nasal part belongs to the posterior part of the skull. The nature of the bone and the adherent matrix as well as the jointed part between the nasal and the frontal show that it is most probable that we have to deal with one individual. In any way it is more or less displaced. It seems to be also a specimen representing a mature individual. The sutures among various bones are in most cases less clear. But in general shape and structure, we failed to find any noticeable difference as compared with the previous described specimens (Fig. 4, B).

**Skull roof V.2509, V.2510 and V.2511 from 56173.** V.2509 represents a skull roof with the part from the posterior of the nasal to the interparietal and the parietal preserved. The prefrontal and postfrontal are only partly preserved. The "boss" at the middle of the parietals as well as the sutures between the frontals and the parietals are well shown. In all details it agrees with those of the previously described specimens.

V.2510 is a skull roof with nearly complete frontal part and its surrounding bones. The ventral side is also shown.

V.2511 (Fig. 5, A, p. 9) shows the posterior part of the nasal, both prefrontal, and post frontal parts of both postorbital and anterior parts of the parietal. The ventral side is well preserved.

Both the V.2510 and 2511 agree in every detail in structure with the other specimens. They seem to represent rather adult individuals.

**Skull roof V.2501 from Sunchiakou, Ehrmaying, Ningwu.** This is a well preserved skull with part of postcranial bones which will be described latter. The skull itself has only the roof part of the frontal and the surrounding bone but it is the only skull in our collection with the part of foramen magnum, and its related bone as well as the basisphenoid well preserved. The anterior part of the frontal and both sides of the skull especially the right side, are damaged. The less clear sutures among the bones and the unusual thickness of the bones indicate that we have to deal with old individual. The isolated left nasal belongs almost certainly to this skull although we failed to get the real contact with the skull (Fig. 6, p. 10).

Looking from *the top* the following notes may be given in addition to the observations made on the skulls of 56173.

The *interparietal* process is comparatively long with rounded termination, its tip is however broken like that of the other specimens. The "boss" of the parietal is well formed but with no longitudinal ridge and not so prominent as that of the type. The suture between the parietal and the frontal is well marked, also that of the prefrontal (left side) and the frontal as well as the postfrontal and the frontal (right side) but not so clear. The relative position and the general structure are the same as those of the other specimens. The tip of the both sides of the posterior processes of the parietals is broken. The processes form a rather rounded curvature as compared with other skulls. The ridge of the posterior margin of the parietal is prominent and overhangs distinctly over the occipital plane of the skull. The *right nasal* is nearly complete, the tip is however broken. The zigzag connection with the frontal is well marked. The constriction posterior of the second anteorbital opening and the downward extension are very expressive. The insertion groove for the reception of the posterior process of the premaxilla is deep. The whole nasal is conspicuously vaulted. In the ventral side the two longitudinal ridges are especially prominent. All these features are in agreement with the old age of the individual.

In the posterior view of the skull, it displays the unique case which shows the occipital plane of the skull. The upper part of the occipital plane is made by the posterior processes of the parietals and the interparietall as in *Vjushkovia* but with distinct posterior process of the interparietall in our form. Although the both ends of the parietal process are broken, it extends most probably also not so wide as the opisthoticum (paroccital). The depression at each side of the interparietal is more distinct due to the stronger overhanging of the parietal process mentioned above.

Below the interparietal and between the roots of the parietal process there develops a much strong process posteriorly directed immediately above the supraoccipital. The situation of this process is so low that it cannot be considered as the continuous part of the interparietal process. It has a length about 29 mm measured from the dorsal side. The root of the process extends very low just against the upper border of the supraoccipital, also 29 mm and only 14 mm from the upper margin of the foramen magnum. The breadth at the base is 21 mm and at the tip, 13 mm with rather rounded end. At the ventral side, a distinct ridge is developed. This is evidently a prominent process. The suture surrounding this process is not quite clear except that with the interparietal. It must be regarded as a special development either of the process of the parietal which is more probable or of the supraoccipital. The above described process is indicated by the figure of *Chasmatosaurus* given by Brink (1955, p. 143) but not mentioned clearly

in his text. In all the known specimens of *Erythrosuchus* and its related forms this part is not preserved. It is highly probable that such a process of the parietals occurred in those forms. There is no doubt that this process serves as a sort of articulation as suggested by Brink.

At the side of this process, somewhat lower in level, and between the parietal process and the Opisthoticum the *fenestra posttemporalis* is well developed (better shown at the right side).

The *supraoccipital* forms the upper border of the foramen magnum but its sutures with the neighbouring bones are not clearly detectable. It may be present when observed more closely and carefully that such separation with both the posterior process of the parietal process and opisthoticum seems to be faintly indicated. Its outline seems to be more expanded laterally.

The *opisthoticum* (paroccipital) is well preserved at both sides. It seems that it takes comparatively a small part of the border of the foramen magnum. The bone expands only slightly distally and also thinner. A prominent broad ridge, starting at the side of the supraoccipital, extends laterally and vanishes about the middle part of the bone. At the upper view of the left one the distal part of the contact with the parietal process is well marked and lies about one third of the whole length from the end of the bone. In ventral view the deep groove near the base of the bone is well marked.

The *condylous occipitalis* is very massive and projects strongly backwards with a conspicuous constriction near the base. Its posterior outline is rounded triangular with upper border marked by a broad furrow. The condyle is divided into three parts when viewed from below. A transversally oriented furrow is divided by a vertical median one at the middle where the lowest part of the bone is located. At the border of the condyle especially the lower part, it is perfectly smooth, representing the articulated part of the bone.

The *foramen magnum* is comparatively small. The transversal breadth is 30 mm and the height is 19 mm.

In lateral view of the skull, it shows the side view of the brain case with the part of the frontal, prefrontal, parietal, opisthoticum, condyle and the basiphenoid more or less represented. Several foramina for nerves and carotid are well indicated as given in figure 6, p. 10.

On the whole, the structure of the skull of Ningwu shows in general the same as that of *Erythrosuchus*, except the curious development of the horn-like backward projecting made of the parietals below the interparietal and the absence of the parietal foramen. There is no doubt that the skull V.2501 belongs to the same species of the material described above, except that it is an old individual.

## Description of the isolated bones of the skull

In our collection there is a considerable amount of isolated bones, almost exclusively from 56173, of the skull. They display important informations concerning the structure of the cranial part especially the shape of the skull and the number of the openings etc. They are described below. Those already described above will be treated only briefly.

Besides the above described eight skull roofs there is only one with the ***parietals, frontal*** and ***prefrontals*** partly in connection. There are a few with the frontal and prefrontal in connection. In addition there are many isolated parietals, especially the posterior processes, frontals and prefrontals. There is no noticeable difference as concerning the structural significance except their age.

There is a nearly completely preserved left ***postorbital*** (and a few broken ones) which needs special description (Fig. 7, A, p. 12). It is a specimen of rather old individual, somewhat robuster than the same bone of V.2506. The contact with the postfrontal is broad and thick. The bordering of the supra-posterior

part of the orbit, lateral part of the supra-temporal opening and the supra-anterior part of the lower temporal opening is well defined. The weak concave part near the base of the suture with the postfrontal and at the base of the lower process is not so distinct as that of V.2506, due probably to the mature age. The concave part at the distal part of the posterior process is, however, well marked. The contact with the upper branch of the jugal is marked by broad expansion with rough surface. In the inner view, it shows the remarkable thickening of the lower process and the deep excavation right below the contact with the postfrontal.

There is another specimen with part of postfrontal, postorbital and parietal of the right side preserved (Fig. 2, B, p. 7). This is only specimen showing almost the entire outline of the supratemporal opening besides that of V.2501, but in better condition. The supratemporal opening is triangular with the lateral border almost parallel to the axis of the skull and the inner angle is rather acute. The posterior lateral angle must be also acute but evidently greater than the inner one.

The isolated pieces of ***occipitals*** and ***basisphenoids*** are mostly fragmentary or sometimes dislocated so that it adds little to what has been described previously. Figure 5, B (p. 9) shows the anterior and lateral views of this part, which are essentially the same as that of V.2501 but smaller representing a rather young individual. There are also several isolated basisphenoids of quite young individual. Many isolated pieces of *opisthoticum* with mostly young ones are found.

The ***nasals*** are abundantly represented besides those already described above with the skull roofs. The isolated ones are mostly fragmentary, the right and the left are often separated and the both ends are generally lost. There are many young ones. In many cases it shows that the insertion furrow of the posterior process of the premaxilla and the posterior border of the second anteorbital opening is preserved. The downward extension is sometimes remarkably low. Figure 7, C. shows a right nasal of old aged individual with the furrow for the posterior process of the premaxilla extending rather backwards and the downward extension of the part of anterior border of the anteorbital opening rather low. In all the collected specimens there is no sign of any remarkable difference of structural significance except the age.

The ***lacrymal*** is very poorly represented and also rather doubtful. One pair of this bone is still sticking to one skull roof with frontal and its surrounding bones. Only one isolated right lacrymal is found (Fig. 7, B, p. 12). The outline of the bone looks rather similar to that of *Stagnolepis*. The middle part is constricted and the anterior extension is remarkable. It seems that the location of the lacrymal is well in front of the lower process of the prefrontal as in the case of *Chasmatosaurus vanhoepeni* described by Brink.

**Premaxillary.** None of these bones is found in natural connection with the skull roofs described above. Its association with them is doubtful. For the purpose of the reconstruction, of course in composite way, some of them were used according to the size and nature of the sticking matrix etc. They are very conjectural.

Only a few of the premaxillaries are completely or tolerably well preserved. The best ones are given in figures 8 and 9 (p. 12, 13) including the individuals from very young to old. The complete specimen shows without any doubt that two openings are formed in the present described new form. The upper, the nasal opening is bordered by the shorter anterior upper process which inserts to the inner groove of the nasal and the long middle process inserting to the middle groove of the nasal. The somewhat posteriorly situated opening is anteriorly bordered by the long process on the top. In most cases, the anterior shorter process is either broken or lost or wound during life. The tip of the middle process is also usually broken. In many cases the lower part is incomplete.

The bone is only weakly convex externally. Along the lower border there are at least six foramina for nerve canals, more distinct in adult specimens. At the posterior upper border, near the anterior lower part of the second anteorbital opening, there is an elongated deep furrow extending anteriorly and upwards and then branching into three shallow grooves. These are also distinct in adult specimens and less clear in younger ones. The anterior border of the premaxilla is generally nearly straight but weakly concave in many specimens. The anterior short process, when preserved is delicate and flat at the inner side. The long middle posterior process shows always a deep long groove at the inner side and a flat surface at the top in adult specimen and less clear developed in other specimens. Between the two processes at the inner side, the symphysis represents the thickest part of the bone. The inner side of the symphysial part is flat and extends and narrows downwards gradually up to the alveole border. At the upper part between the symphysis and the roots of the posterior process there is a triangular flat surface well developed in many adult specimens. Posterior of it, the anterior border of the choane is weakly indicated. In many cases traces of teeth or impression of the same are indicated.

**Maxillary.** Most of the maxillaries are fragmentary. Some of them are so poorly preserved that it is difficult to tell to which side they belong. Yet, the better specimens are sufficient to give a fairly idea about their shape and structure.

First it seems to be quite sure that the almost flat or even very weakly concave side has to be considered as the labial side and the rather convex or weakly swelling side represents the lingual side. The reasons are: the higher border of the alveole lies at the flat side, the same for the alveolar canals and the deep furrow. If preserved, at the lower part of the anterior end fits exactly with that at the lower posterior end of the premaxilla.

In external aspect the highest point of the maxilla lies the upper process which is broken in most of the specimens. This process separates the second anteorbital and the first anteorbital opening. Its root starts from the anterior middle part of the outer side and extends upwards. The lower part of the anterior side of the process is almost perpendicular, slightly bending backwards, to the alveolar border. The specimen in figure 11 (p. 14, see also pl. I) shows the anterior part of the first anterior border clearly and also partly shown in others in figures 10 and 11 (p. 13, 14) which give also the minor differences of the process (Fig. 10, C. may belong to *S. heiyuekouensis*). The lower border is distinctly convex, especially below the mentioned process. The maxilla narrows remarkably backwards and ends almost in pointed manner. There is weak ridge just below the lower border of the two anteorbital openings across the root of the upper process, evidently for muscular attachment.

The inner side of the bone shows a conspicuous internal border much higher in position than the external side with the zigzag part right below. In dorsal aspect, the maxillary looks perfectly straight without lateral anterior bending like that of *Vjushkovia*. The thickening part with a distinct shelf in front of the upper process marks the contact with the palatine and a much fainter one posterior to it for the reception of the pterygoid. At the posterior part of the upper jaw the groove on the upper border marks the contact with the jugal.

The size of the maxillaries varies greatly as shown in the giving figures. In figure 10, C. it represents one of the smallest jaws yet in adult stage which may belong to the following described form while there are several thin specimens almost flat in both sides, representing actually the real immature individuals.

**Jugal.** All of the jugals are found isolatedly. By various parts of this bone, it is possible to get the real shape which is important for locating and at least estimating the shape of the lower part of the lower temporal and orbital openings. The upper process in connection with the postorbital is almost perpendicular

to the axis of the bone. The anterior angle is slightly greater than a right angle while the posterior one is widely rounded. The lower border right below the upper process is decidedly concave upwards. The anterior process in connection with the maxillary and lacrymal is abruptly truncated and bends sharply upwards. It is very probable that this end of the process takes part in making the lower posterior border of the first anteorbital opening. The anterior process is comparatively thicker than the other part of the whole bone. The posterior process is broader and thinner than the anterior one. It expands a little and then narrows suddenly in order to make a rather thin and pointed end. This process covers externally the anterior process of the quadratojugal (fig. 12, p. 15).

On the whole the jugal of the present form looks very much like that of *Vjushkovia* according to the reconstruction of Huene (1960. pl. XI, I) except that lower posterior process covers externally the quadratojual, and some other minor differences. The bone must be oriented more upwards anteriorly so that it forms an upwards concave part with the maxiliary in lateral aspect.

The size and the thickness of the jugal vary considerably. Figure 12 E p. 15 shows the posterior end of the left jugal from Ningwu (V. 2501) which is considerably larger and thicker. It is this specimen which proves that the posterior part of the jugal lies at the external side of quadratojugal.

**Quadratojugal.** This is a triangular bone with the anterior extension for the contact with the jugal. It is rather convex externally. The lower margin is comparatively thicker, especially the posterior part. At the posterior lower end, there is a shallow depressed area on the inner side, evidently for the connection with the external end of the quadrate. The upper end is rounded moderately. The anterior extension is rather narrow with the distinct impression for the jugal, its posterior point extends very much backwards just below the upper point. At the anterior border of the bone immediately above the anterior extension, the bone is considerably thick with a deep furrow along the lower part of this border. The furrow vanishes at the upper part and it is for receiving the lower end of the squamosal (Fig. 13, D-G, p. 16).

**Quadrate.** Only two among a great number of quadrates are nearly complete. This bone is essentially similar to that of *Vjushkovia.* It is very probable that the medial wing in connection with the pterygoid is nearly completely preserved in the two specimens. If so, the maximum extension with contact for the pterygoid lies rather low. The proximal end looks rather small as compared with the large and heavy skull. Lateral wing is only about 22 mm wide throughout the whole length between the two articulation ends. The both wings form an angle about 90 degrees. Looking posteriorly the bone is distinctly constricted above the distal end. The posterior view of the part above this end is flat and deeply excavated on the other side. The both joints form an angle about 40 degrees (In the specimen figured in figure 13, A., the lower end is probably pathologically deformed so that a boss is developed above the distal end) (Fig. 13, p. 16).

**Squamosal.** This bone is represented by a few of rather well preserved specimens, but none of them is complete and found in connection with the skull. It is a long bone externally strongly convex and medially concave. In most of the specimens, the impression of the posterior process of the postorbital is well marked. It is indicated by a sharp pointed area almost near the very posterior border of the bone and directing somewhat laterally. Behind this part there is a flat or rather weakly convex surface (usually in old individuals) for the connection with the parietal process. The anterior border is more or less shown which represents the posterior border of the lower temporal opening. The upper and posterior border is quite obtuse and curves gently backwards. An oblique conspicuous ridge starting from the posterior end of the impression of the postorbital process runs down and slightly anteriorly and vanishes near the anterior border of the bone, This is evidently for the attachment of the temporal muscle. The lower part of the bone thins gradually with a blunt point as the connected place with the quadratojugal which forms also the lower posterior corner of the lower

temporal opening (Fig. 14, A-C, p. 17).

The preserved squamosals are varing in size. The larger ones are decidedly more robust and thick while the smaller ones are delicate and thin. In all of them the oblique ridge is sharply developed. Although they vary in some details of the structure yet it seems no doubt that they all belong to the same species.

**Pterygoid.** Only two incompletely preserved pterygoids are found in the entire collection. The better preserved ones show the essential part of the bone and looks very similar to the inner side view of the samè bone given in plate VII 82b of *Erythrosuchus aficanus* (Huene. 1911), apparently also the left side. But to orient with our reconstructed skulls (see below), it is impossible to connect the slender process at the upper left side of the figure with the quadrate, but rather nicely with the lower broad one of which is unfortunately much damaged. The following description is tentatively based on this orientation.

The specimen belongs probably to a young individual. The part in connection with the basisphenoid is much constricted. The anterior part of the pterygoid is formed by two parts. One extends anteriorly forming the main part of the ventral part of the mouth. It is marked by a conspicuous ridge and a broader one median to it. The two ridges connect each other near the contact surface of the basisphenoid. The other part extends upwards forming an angle somewhat less than 90 degrees. A very sharp ridge is formed at the posterior border with a pointed end. The posterior part for the connection with the quadrate is broad and seems at a plane somewhat twisted with the vertical plane of the anterior part of the bone. Looking ventrally the part near the contact with the basisphenoid is rather narrow. The border of the interpterygoid vacuity is indicated. Then the bone narrows considerably anteriorly and the tip of which is broken. There is no indication of the presence of pterygoid teeth (Fig. 15, A, p. 17).

The other pterygoid is too fragmentary for description. It belongs probably also to a right one. But the part in real connection with the basisphenoid that means the median extension of it, is better preserved.

**Palatine.** There are three other bones which can only be best considered as the palatines. Two of them belong apparently to the left side of which one is nearly completely preserved and one to the right side. The weakly kneelong border is for the contact with the pterygoid. At the lateral part the border for the internal nares and the suborbital opening is indicated (Fig. 15, B and C, p. 17).

There is no other sure bone of the skull. Indication of the cornus branchialia may be seen at the vental side of the type skull and that of V.2508 but in less clear condition.

**Table 4. Important measurements of various elements of the skull (in millimeters)**

| | |
|---|---|
| **Skull roof:** | |
| Length of the skull (preserved part with estimation of both ends) | 440 (V. 2503); 420 (V. 2506); 470 (V, 2507); 450 (V. 2504); 430 (V. 2505); 560 (V. 2501) |
| Length of the skull from posterior end of interparietal to the anterior medianm end of the frontal | 214 (V. 2503); 186 (V. 2506); 199 (V. 2507); ?216 (V. 2504); 204 (V. 2505); 230 (V. 2501) |
| Lateral distance between the parietal processes | 186 (V. 2503); 154? (V. 2506); 211 (V. 2508); 206 (V. 2504); ?165 (V. 2505); 226 (V. 2501) |
| Lateral distance between the opsthoticum | 256 (V. 2501) |
| Height of the skull from the top of the anterior part of the parietal to the lower anteruot end of the basisphenoid | 175 (V, 2501) |
| Inter-supratemporal openings breadth | 80 (V. 2503); 60 (V. 2506); 69 (V. 2507); 74 (V. 2504); 63 (V. 2505); 86 (V, 2501) |
| Interorbital breadth | 152 (V. 2503); 126 (V. 2506); ?162 (V. 2508); 166? (V. 2504); 133 (V. 2505); 150 (V, 2501) |
| Length and breadth of the prefrontal | 117×50 (V. 2503, left); 84×41 (V. 2506, right); 94×47 (V. 2505, left) |
| **Postorbital.** (mounted provisionally with the type skull). | |
| Length from the lateral anterior point to the posterior end | 138 |
| Length from the lateral anterior point downward to the lower tip | 138 |
| Breadth between the supratemporal and orbital opening | 39 |
| Breadth between the supratemporal and infratemporal opening | 24 |
| **Nasal.** | |
| Estimated length and maximum breadth of the robust left nasal (mounted with V. 2501) | 330×65 (total breadth) 130 |

**Lacrymal.**

Preserved height of the isolated right one ············62

Preserved upper length in contact with the prefrontal ············64

Minimum breadth between the orbit and the first preorbital opening ············24

**Premaxillary.**

Right premaxillary: the length along the tooth row 106 (left). ············89; (both are mounted by with the type skull V. 2503)

Length of the same from the anterior border of the symphysis to the posterior tip of the middle process ············ 186; 201

Height from the lower border of the nasal opening to the lower margin of the tooth row ············71; 84

The three above-mentioned measurements of the left premaxillary mounted with V. 2504 ············ 120; 224 and 95

The same of the left premaxillary mounted with V. 2505············ 89;——; 86

The same of the left premaxillary mounted with V. 2501 ············147; 250; 110

**Maxillary.**

Total length of the left one mounted with V. 2501 ············ 205

Height before the upper process of the same ············69

Behind the upper process of the same············73

**Jugal.**

Height of the left jugal mounted with the type skull V. 2503 along the process in connection with the postorbital ············ 129

Length of the left jugal from the middle of the upper process along posterior process up to the end············ 135

Length of the anterior end in connection with the maxillary············ 111. (not mounted one)

Breadth and thickness of the posterior process of the left jugal of the skull V. 2501 ············ 55; 9

**Quadratojugal.**

Length of the right jugal mounted with the type skull V. 2503············ 164

Height of the same from the lower margin to the upper tip ············ 145

The length of the left quadratojugal of the skull V. 2501 ············ 186

The height from the base to the upper tip ············ 141

**Quadrate.**

Height of the right one mounted with V. 2506 ············ 179

Breadth of the median extension of the same ············74

Width of the lower condyle ············46

Lateral width of the condyle with the squamosal············17

The same measurements of the right one mounted with V. 2508············205; 98; 52; 15 respectively

The breadth of the right quadrate (lower condyle)············68

**Squamosal.**

Total length of the right squamosal mounted with type skull ············ 159

Minimum breadth from the anterior border to the part below the recess for the condyle ············40

Total length of the left one mounted with V.2504············ 129

Breadth at the upper middle (minimum) ············30

**Pterygoid.**

Total preserved length············ 260

Minimum breadth ············ ?24

**Palatine.**

Preserved length············ 145

distance between the choane and the suborbital opening ············43

## Lower jaws

None of the lower jaws is complete, yet the preserved specimens are sufficient for getting a complete picture of the jaw and its essential characteristics. The lower jaw of *Shansisuchus shansisuchus* is characterized by the presence of a large rounded rectangular mandibular foramen. On the other hand, the preserved part looks very similar to that of *Erythrosuchus* (Figs. 16—18, p. 18, 19).

**Articular and suprangular.** No clear separation between these two bones is observable. Several better preserved specimens show the part around the articular joint. There is almost no posterior extension except the posterior wall of the articular facet, In this respect it differs from *Vjushkovia* and many other genera. The articular joint itself is widely open and facing distinctly externally (In the specimen figured in fig. 16

E, the opening is 46 mm). In front of the articular joint, the bone expands considerably anteriorly which is formed entirely by the suprangular. The very prominent horizontal ridge is developed below the upper margin. It is especially strong at the anterior part of the articular and becomes weaker anteriorly and vanishes at last above the mandibular foramen. In the specimen figured in Fig. 16, E. the distance between the mandibular foramen and the articular joint is 105 mm. The former is partly represented in the same specimen which shows a rounded rectangular outline at least the posterior part. It extends rather anteriorly and downwards. The anterior border of the foramen is made of the posterior part of the dentary as shown faintly in the specimen figured in Fig. 16, C. 'This is the only specimen in our collection which shows the dentary in natural connection with the suprangular. The groove at the anterior lateral part of the suprangular is well indicated in all better preserved specimens, especially the relatively younger individual represented by the specimen figured in Fig. 16, D. In lateral aspect posterior end of prearticular is faintly observable. The same is for the supposed spleniale.

**Prearicular, spleniale and coronoid.** These three bones are observable in the best preserved specimen in fig. 16, E. The almost horizontally oriented and rod-like bone is certainly the prearticular. A lateral and downward thickening almost immediately before the posterior end is distinct. Its anterior end is broken. Below this bone at the lower border of the jaw, there is a bone with the maximum height at the middle and narrows considerably towards both ends (the anterior end is not complete). This can only be regarded as the spleniale. Above these two bones the oblique ridge at the median side as the anterior median extension of the anterior wall of the articular facet may be interpreted as the coronoid. All the three bones are practically in their original position.

**Angular.** In addition to many fragmentary pieces of this bone, there are two nearly complete, both of the right side (Fig. 16, A and B). This bone is remarkably similar to that of *Erythrosuchus* described by v. Huene. The posterior end of our form is more obtuse and almost no sharp extension. The lower border is weakly downwards curved with a lower lateral flat surface. In the rather younger individual (Fig. 16, A), this surface faces more downwards, so that it is scarcely seen in lateral view. Total preserved length of the A, 285 mm. and of B, 335 mm. Maximum height of A, 44 mm and of B, 56 mm.

**Dentary.** Only a few of the dentaries are nearly complete, most of them are represented by the part of the anterior end. In some cases some teeth are still in natural position of the jaw. The better preserved ones are figured in figs. 17 and 18.

On the whole the lower jaw is slender. The lower border is nearly straight. The anterior end or the symphysis is considerably rather thickened with more or less distinct radiated furrows starting from the lower border. The inner surface of the symphysis is flat while the external side is weakly convex. The median side of the posterior part of the jaw is marked with a thin flat area with an anterior acute end for the locating of the spleniale. The forked part for the anterior border of the mandibular foramen is not preserved in most of the specimens but must be doubtlessly so. A longitudinal groove is generally observed at the outer side of the jaw, more distinct in younger specimens and less so in adult ones. The posterior part of the jaw expands only very slightly, so that both the upper and the lower borders of the jaw are nearly parallel for great length, except the thickened anterior end.

## Dentition

Comparing with the richness of the upper and lower jaws, the teeth are relatively poorly represented. Most of them are found in isolated conditions. Only a few teeth are found in natural position of the jaw. Although there are so many upper and lower jaws in our collection it is not sure about the actual number

of the teeth except that of the premaxillary which is certainly five in number. The most complete maxilla bears at most 10 and more probably nine teeth. The better preserved lower jaw shows most probably that the estimated number of teeth may range from 14 to 16 (Fig. 19, p. 20).

The teeth are typically sub-thecodont.

The teeth of the premaxilla are extremely long rooted with rather short crown. The crown is rather lanceolated in outline in side view with very weakly backward bending. It is rather finely serrated both in anterior and posterior sides. The root is generally four to five times longer than the crown. It is more or less laterally compressed. In the aged individuals the cross-section of the root may be oval or even sub-circular. The root has its maximum breadth and thickness at the middle part. The cavity of the root is large. It is impossible to determine the real sequence of the single tooth. But judging from the alveoles of the better preserved premaxillaries it seems that the first one is smaller than the succeeding ones and the size of the teeth decreases from the second and the third one, which are the largest, considerably backwards. In many specimens the substituted teeth may be observed below the fuctional ones. They are of course much smaller. Many of the small isolated teeth belong to this kind of tooth.

Only a few of the maxillary teeth are still in natural place of the alveoli in some of the maxillaries (Figs. 10 and 11). Nearly all of them are fresh and unused. The inner alveolar border is nearly straight or rather convex, much higher than the more or less corresponding curvature of the labial side. Below the lingual alveolar border the peculiar zigzagged, more or less well triangular in shape bony plates are developed, much similar to that of ?*Arizonasaurus babbitti* described by Welles. Only the zigzagged form and the triangular structure are still better developed in our form. As noted above the lingual side of the upper jaw is convex, also the same as that of the specimens of the same author.

The maxillary teeth are much more compressed than those of the premaxillaries. They are also more backwards bent. Both the anterior and the posterior sides are finely serrated. In one specimen (Fig. 11, C.) there are three younger newly erupted teeth and one longer and used tooth. It seems clear that two other empty alveoli (marked as 1 and 5 in the given figure) represent the other two used teeth which are fallen. It is clear that the using teeth and the subsititute one are arranged in alternative manner (In the same figure they are marked as odd and even numbers respectively).

**The teeth of the lower jaw** are less so distinct as those of the upper. It seems quite probable that the long rooted but short crowned and distinctly more backwards bent and pointed teeth are the anterior teeth of the lower jaw. None of them is seen *in situ* of the lower jaws except that some specimens show the more rounded powerful root. Comparing with the upper anterior teeth they are generally more slender, more pointed and the crown is somewhat longer. They are represented by numerous isolated ones of various ages. The exceedingly younger ones show clearly their less compressed nature and evidently also more pointed and bending backwards. They are also serrated on both sides and generally rather coarse as compared with posterior teeth.

The remaining lower teeth are very similar in structure as those of the upper. Therefore, it is sometimes difficult to distinguish the isolated post premaxillary and the posterior lower teeth. Same as the upper teeth, they are generally sharply compressed and serrated on both sides and backwards bent. Yet, some of the isolated ones show more or less rather transversal thickening of the base of the crown and the root. It depends probably on the age of the individual. In the specimen figured in fig. 17, A (p. 19), the newly fuctional teeth decreasing in size posteriorly and it shows also, like that of the upper, the alternation of using and substitute teeth.

On the whole the dentition of *Shansisuchus shansisuchus* is horribly carnivorous much comparable with

the later fresheating dinosaurs. It must represent the most aggressive beast during the time of *Sinokannemeyria.* Structurally speaking they are rather simply built. Functionally the anterior teeth are chiefly used for attack while the posterior ones for cutting.

## The reconstruction of the skull

Finally we may be in a position to discuss to some length concerning the reconstruction of the skull so far described. The attempt is of course a preliminary one. It may include several points which are more or less tentative or even in error, since nearly all the material used are found isolatedly and in many cases fragmentarily. A few bones are missing or very poorly represented. On the other hand, the rich collection gives it possible to get a fairly complete idea concerning the structure of the head (Fig. 37, p. 42, Plates IV-VI).

By using the better preserved skull roofs, six skulls with lower jaws are reconstructed. Needless to say that all of them are composite ones. In some cases they are not exactly fit in size. Nevertheless, the basic structure and the outline or the shape of various openings are reliable to a great extent.

In the type skull roof (V.2503) the composite parts are fairly complete, only a few bones are left missing. The left postorbital (and also the partly reconstructed right one) looks a little too large for this skull. Otherwise, the other parts seem to fit well with the skull roof, although they may not belong to the same individual. It represents a mature individual.

The skull roof with the cranial part partly preserved (V.2506) represents an individual somewhat younger than the previous one as indicated by the loose contact of the frontal and the nasals and the delicate nature of the lower process of the postorbital. Yet, it can not be too much in difference of age as compared with that of the type as proved by the sutures of various other bones. The other bones mounted with this skull may be a little too robust but fit rather well in general.

The bones mounted with the skull roof V.2508 fit well in size but in a rather incomplete way. It is a adult one.

The bones mounted with the skull roof V.2504 fit also well except the maxillae which may be somewhat too small. It represents fairly a large individual.

V.2505 represents a young individual. But it is not the youngest one among our collection, since we have several maxillae and other bones which are still smaller and younger than the skull roof. However, the maxillae mounted with this roof are evidently too large for this individual. The same may hold true for the premaxillaries.

In order to get a fairly complete idea about the skull remains of Ningwu with most part of the roof and the posterior part preserved (V.2501) from Ningwu we have tried to use the isolated bones of Wuhsiang (56173) in mounting this skull, the premaxillaries and the maxillae. The left side of these (the right premaxillary is duplicated from the left side) two bones are fit so well by the groove connection with these two bones that they are doubtlessly belonging to the same individual. Yet, one has the impression that the left and also the right maxilla looks a little too small for the large premaxillary. V.2501 represents obviously a very large and old aged individual. It is the largest skull among the whole collection.

All the lower jaws including that of V.2501, mounted with the above noted skulls are more or less subjective. They may not fit well in size. In each reconstructed lower jaw the anterior part and the posterior part may not belong to one individual.

By the reconstruction of these six skulls, we are able to have a fairly reliable idea about the shape and structure of *Shansisuchus shansisuchus,* although many points may remain dubious. The chief characteristics

may be given as follows:

The length of the skull is controlled by the median length of the part between the interparietal and nasals plus that of the premaxillaries. The missing part of the anterior end of the nasal can easily be corrected, fitting the posterior process of the premaxillary with the corresponding groove of the nasal. The lower length of the skull is controlled by the total length of the lower border of premaxilla, maxilla, jugal and quadratojugal. According to the present reconstruction the quadrate cannot be seen in lateral aspect. By doing so, the quadrate is only slightly slanting backwards, much the same as that of *Erythrosuchus* and other related genera. In this manner, the height of the posterior part of the skull is conditioned. On the whole the posterior plane of the skull is almost vertical in position or only slanting weakly backwards. The posterior breadth of the skull is controlled by the mounting of the squamosal, quadrate and quadratojugal. The interbone articular contact between the postorbital and squamosal and quadratojugal make their position rather fixed. In this way the distal end of the both quadrates are only very weakly expanded laterally.

Since most of the symphysis of the lower jaws are not well preserved and the posterior part of the same is fragmentary, the angle and position of the lower jaw are mainly put according to the way that it is fitted with the articular part of the quadrate.

In mounting with the six skulls the result is more or less the same so that we think it is not far from the truth.

In top view of the skull, it is long triangular in outline with pointed snout. Both the supratemporal openings and the nasal openings can be seen wholy in top view, while the others are for great part concealed. The same is for the occipital plane.

In lateral view the skull looks also long stretched with the maximum height at the posterior end. The slanting of the occipital plane is almost negligible. With the exception of the supratemporal opening which is directed upwards and only a small part of it is visible from the side, the other openings can be seen in lateral aspect. The upper border makes a very gentle slope from the summit of the interparietal to the tip of the premaxillaries. The lower border is weakly undulating. It is chiefly caused by the kneeling between the premaxillary and the maxilla, the upward bending of the anterior part of the jugal and perhaps also the same at the part below the lacrymal. The former one is evidently very weak and nothing to compare with that of *Elaphrosuchus, Chasmatosaurus* etc. and about the same condition as that of *Erythrosuchus* and *Garjainia.*

The posterior view of the skull is less sure. It is only partly shown in the skull of Ningwu (V.2501). Nevertheless, the mounting of the six skulls shows that the distal part of the quadrate is only slightly expanded laterally. The whole outline looks almost square in shape, but actually the height exceeds a little than the breadth, in contrast to that of the reconstruction given by v. Huene for *Erythrosuchus.*

Since the bones of the ventral side of the skull are rather imperfect, no atempt is given for this part of the skull.

In lateral view the lower jaw looks slender as compared with the large skull. Since there is no single complete lower jaw preserved, the total length of it can only be estimated. Very probably the anterior end of the lower jaw lies somewhat backwards but not in such a degree as that of *Garjainia* for instance. The weakly upwards bending of the upper border of the lower jaw seems to correspond with the downward convexity of the maxillae.

The supratemporal opening is completely preserved in many cases and needless to discuss here. It is bordered by parietal and postorbital but the squamosal takes also a little part at the posterior lateral angle of the opening. The anterior border is almost perpendicular to the longitudinal axis of the skull and the

lateral border parallel to the same. The posterior lateral angle is very acute.

The lower temporal opening is bordered by postorbital and squamosal at the top, the postorbital and jugal at the anterior side, the squamosal and the quadratojugal at the posterior side and the jugal and the quadratojugal below. The very obtuse angle of the upper and anterior, the less obtuse angle of the upper posterior, the very obtuse angle of the lower anterior and the nearly right angle of the lower posterior corner are actually represented by more than one specimen of postorbital, squamosal, jugal and quadratojugal respectively and thus all are reliable. The opening is rounded rectangular shape with the height exceeding distinctly the breadth. In addition the upper border is distinctly shorter than the lower one and the anterior border is shorter than the posterior one. No kneeling is developed on the posterior side of our form.

The orbit is bordered by the postfrontal and the prefrontal at the top, the lacrymal at the front, the jugal at the lower and the postorbital at the rear. As noted above the frontal is excluded from the border of the orbit. Since the lacrymal and the jugal are poorly represented the outline of the orbit is not so definitely clear in some points. Nevertheless, in the skull of V.2506 is rather reliable, as all the bones at the upper and posterior corners of the orbit are intact. The contact of the anterior jugal with the lacrymal is rather obscure. According to the present reconstruction the outline of the orbit is nearly rounded oval with posterior upper prolongation as the proper place of the eye which is bordered by the prefrontal, postfrontal and upper parts of the lower process of the postorbital.

The shape of the first anteorbital opening is fairly defined, except the posterior part which is bordered by the lacrymal. The upper part is bordered by the nasal and the lower part by the upper margin of the maxilla. The connection between the downward extending process of the nasal and upper process of the maxilla is positively indicated by many specimens, although not complete. That the connection between these two processes forms the actual separation of the first from the second anteorbital opening is obvious and doubtless. The posterior border is formed by the lacrymal. It seems also certain that the anterior end of the jugal is in contact with the posterior part of the maxilla. The outlinc of this opening is rounded triangular. Its size is intermediate between that of the orbit and the second anteorbital opening.

The second anteorbital opening is posteriorly separated from the first anteorbital opening by the upper process and the downward extension of the nasal. The upper border is defined by the posterior process of the premaxillary and the nasal. It slopes downwards and anteriorly and then forms an angle by the premaxillary. The lower border is made of the posterior part of the premaxillary and the anterior part of the maxilla. In outline it is also rather triangular but with a upper and posterior corner made of the nasal. On the lower posterior part of the premaxillary there develops a deep broad furrow extending posteriorly in order to meet the corresponding part of the anterior part of the maxilla. In this part of the two bones it is distinctly inwardly excavated as the lower extension of the lower border of the second anteorbital opening. The anterior lower angle of the second anteorbital opening lies for a part below the posterior angle of the nasal opening.

Comparing with the largeness of the skull and also with tl.e other openings, the nasal opening is rela-

**Table 5. Principal measurements of the reconstructed skulls (millimeters)**

| | V. 2503 | V. 2506 | V. 2504 | V. 2508 | V. 2505 | V. 2501 |
|---|---|---|---|---|---|---|
| Total median upper length | 523 | 565 | 515 | 540 | 465 | 620 |
| Length along the lower border | 600 | 620 | 625 | 665 | 495 | 670 |
| Posterior height | 250 | 240 | 210 | 230 | 180 | 280 |
| Distance between the quadratojugals | 320 | 245 | 250 | 280 | 240 | 430 |
| I.ength of the lower jaw (left) | 600 | 617 | 560 | 580 | 540 | 640 |

tively small. The two nasal openings are separated by the anterior process of the premaxillary inserting to the middle of the nasals. This opening is elongated oval and quite terminusly situated. Its posterior part overlaps partly the anterior part of the second anteorbital opening. It is bordered only by the premaxillary and nasal on the top and the premaxillary below.

Since all the skulls reconstructed are composite, these measurements do not show of course the exact size. But it is quite clear that they actually show the size very approaching the truth, if not exactly, because many of the isolated bones are well preserved and a few missing ones or the partly restored ones are made from the preserved side or the counter part. They certainly give us the relative size variation from the young to the old. However, V.2505 does not represent the youngest individual because we have still somewhat premaxillaries and maxillae which are much younger. No clear indication of newly hatched individual.

## Vertebrae and ribs

Although there are many vertebrae and ribs in our collection, nearly all of them were found in isolated condition and almost no consecutive series more than three or four were preserved. In addition, most of the vertebrae and ribs are very poorly preserved, nearly all of them are represented by the centrums only. Their attribution to the skulls is absolutely uncertain. It is, however, generally possible to classify the neck, dorsal, sacral and caudal vertebrae, but their further exact position is impossibe to determine accuratily. We refrain also from the determination of the many fragmentary piecies of the detached dorsal spines and other broken part of the neural arches.

**Neck vertebrae.** Relatively only a few of neck vertebrae are represented. There is no sure ***atlas*** found but the intercentrum of it is represented by four specimens of various sizes. The most complete one is shown in figure 20, C. It is half-moon-shaped bone viewed from the ventral side. The anterior extension is moderate with transversally extended articular surface with the condyle of the skull. The lateral extension of this articular surface is with the strong ball-like articular surface which is for the contact with the rib on each side, the parapophysis. In ventral view the bone is smooth with anterior and posterior distinct edges. Breadth, 55 mm; ventral length, 21 mm; median height, 31 mm (Fig. 20, p. 23).

There is only one ***epistropheus*** with centrum and neural spine in natural connection (Fig. 20, A). Three similar spines are provisionally referred to those of the epistropheus (Fig. 20, B). The anterior end of the centrum is flat with somewhat convexity at the lower part. Its outline is triangular with a more or less sharp angle at the ventral side. The centrum is strongly constricted in both sides. The posterior side of the centrum is moderately excavated and its height exceeds slightly the breadth. It is very short, being less than half of its breadth of the posterior end. The parapophysis is only weakly indicated at the upper lateral part of the centrum. The neural canal is well rounded. The spina dorsalis is strongly built with the posterior part considerably thickened and a broad groove at the posterior lower side. The upper curvature of the spina dorsalis extends only gently posteriorly and backwards and by far not so steep as that of *Vjushkovia.*

There are several epistropheus without the dorsal spine. They are similarly built as the above described one but with distinct variations. The turn up brim of both borders is developed in the other specimens probably due to the difference of age. The asymmetrical development of both sides is also observed in some specimens. In the specimen figured in Fig. 20, E the right side is almost truncated and scarcely no trace of the parapophysis but abnormally large in the left side. This specimen is not deformed at all and certainly represents a pachyosteological development, similar case is also observed in other epistropheuses.

The following neck vertebrae are distinguished by their shortness of the centrum, the well development of the turn up brim of the anterior and posterior borders and the distinct constriction at the middle etc. We

are not sure about the number of the neck vertebrae but most probably seven to eight excluding the atlas and the epistropheus. Although the actual sequence of the vertebrae is not known but the preserved specimens show that they must increase in length and size gradually and posteriorly.

There is no sure proof of the presence of the intercentrum of the neck vertebrae but may probably be so as in the case of *Erythrosuchus*. The space between two connected vertebrae is however only for a poor development of such structure or totally absent. The ventral side of the centrum is smooth but may somewhat be crested in the posterior ones in older individuals. The parapophysis is poorly developed and only indistinctly observable in the middle neck vertebrae but more developed in the posterior ones. Its situation is variable, generally rather low. They are all weakly amphycoelous. Since no neural spine is preserved in any one of the neck vertebrae, we are not sure about the structure of it. The pre-and post-zygapophysis are preserved in several cases which are rather steep. The diapophysis is preserved in few specimens. It directd almost horizontally and quite prominent in posterior vertebra.

Nearly all the ***dorsal vertebrae*** are isolatedly found and their exact position and individual belongings are not certain except that of V.2501. From the later locality we have six well preserved dorsal vertebrae which may be described first (Fig. 21, p. 25).

There are six dorsal vertebrae of V.2501 more or less completely preserved as shown in figure (Fig. 21). The upper row belongs to the anterior while the lower row to the middle dorsal region. The first two represent certainly the most anterior dorsal vertebrae number 9th and 10th ones, and thus in consecutive series. The first has the left diapophysis still preserved which is short and with massive subtriangular outline. The centrums of both show still the characters of the posterior neck vertebrae, much shorter than the diameter of the centrum and the turn up brim is still well developed at the anterior border. The broadest part of the brim at the lateral side is the position of the parapophysis. The breadth and the height of the centrum are about the same. The centrum is sharply constricted. Its anterior end is only very weakly excavated while that of the posterior end is more deep. The ventral side of the first vertebra shows a faint crest and the lateral part immediately above and behind the parapophysis is distinctly excavated. The ventral side of the second vertebra is marked by two faint ridges and with the median part somewhat depressed. The depression above and behind the parapophysis is more deeply excavated than that of the previous one.

The third dorsal vertebra represents probably the 12th or the 13th one. Although the diameter of the centrum exceeds still considerably the length, but it is relatively longer than the preceding one. It is weakly constricted. There is a distinct ridge at the ventral side near the anterior end but becomes almost unobservable posteriorly. The parapophysis is strongly built and lies at the lower half of the centrum. There is no ridge-like connection between the parapophysis and the lateral part of the centrum. The posterior border of the former overhangs even a little when viewed laterally. The centrum is only weakly amphicoelous. The diapophysis is rather short and directs a little downwards. The prezygapophysis is long and extends much over the anterior end of the centrum. There is a distinct groove developed at the anterior side of the prezygapophysis. The postzygapophysis is short and broad, scarcely overhangs the posterior end of the centrum. The spina dorsalis is relatively short and becomes narrower distally with a conspicuous distal thickening.

The following three vertebrae represent probably the 16th to 18th ones (or 17th to 19th) and thus in consecutive series. The centrums are more deeply excavated, especially the 16th. The centrum of number 16th is relatively short and that of the following two is longer due mainly to the lesser breadth of the centrum and the elongated feature of the centrum itself. The ventral side of the centrum of 16th is smooth while that of the two others is marked by a longitudinal ridge. The parapophysis shifts upwards above the hori-

zontal level of the centrum and is weakly developed. The diapophysis of number 16th directs slightly upwards and rather horizontally oriented in the other two specimens. The prezygapophysis of 16th overhangs slightly the anterior end of the centrum while the postzygaphysis does. The postzygapophysis of the other two vertebrae extends much badkwards and overhangs the posterior end of the centrum. The spina dorsalis of the number 17 is broken. In the both preserved ones the distal thickening is only weakly marked. It is broad and directs somewhat posteriorly.

The other vertebrae preserved in partly consecutive series were derived from the locality 60116 (V. 2513), Heiyukou, Shinghsien (Fig. 22). There are seven vertebrae preserved, one of anterior dorsal (9th or 10th), three of the middle dorsal (probably 14—16) and the two immediately before the first sacral vertebra. The first mentioned vertebra duplicates exactly the features described above for V.2501 and seems too large for the following vertebrae. Its association with them has however little doubt. The next three vertebrae are still relatively short with short diapophysis. The ventral side is smooth. The diapophysis moves much upwards and faint. The prezygapophysis extends only a little beyond the centrum. All these features suggest that they belong to the middle dorsal. The two vertebrae before the sacral I are decidedly elongated. Only the last one bears the neural arch with however the dorsal spine broken. The diapophysis is short and massive. The sacral I bears the same feature to be described below (Fig. 22, p. 25).

With the better understanding of the dorsal vertebrae described above we may have a fairly clear idea concerning the great number of the mostly isolatedly preserved vertebrae of the locality 56173. Although it is not possible in many cases to distinguish the exact position of the vertebrae but it is quite sure to determine the relative position in the column. The anterior dorsal vertebrae are short and with flat or partly keeled ventral sides. There is no clear well defined circular parapophysis. The middle anterior dorsal vertebrae are a little longer and with well defined parapophysis facet near the base of the centrum. Then it follows a few vertebrae with also relatively short centrum and that the parapophysis facet moves upwards and mostly not observable in the centrum. The increase of the length of the centrum to the posterior direction seems to be clear. The last part of the vertebrae or the lumbar vertebrae are all clearly elongated with no trace of the parapophysis. The ventral side is generally smooth but may be sometimes weakly crested. They are seven or a little more in number. We are not absolute sure about the number of the dorsal vertebrae but most probably 17 in assuming that we have 25 presacral vertebrae as it is the case of most thecodonts (Fig. 23, p. 26).

Both the ***sacral vertebrae I and II*** (Fig. 24, p. 26) are represented by many complete specimens, but none of them is in natural connection. The sacral I is varing in size, the anterior end is broader than the height and weakly concave. The posterior end is sub-equal in breadth and height and also concave. The ventral side is smooth. The inferior side in connection with the lower part of the sacral rib extends very low beyond the level of the surface of the centrum. Both facets are connected with each other at the anterior lower end of the centrum. The neural canal as judged by the preserved ones, is much broader than the height. The diapophysis is compact and short. The spina dorsalis is partly preserved in two specimens which is narrow and may not be too long. The sacral II is also varing in size. The anterior end is only slightly bigger than the posterior one. Both are almost flat. In most of them, the lower surface is flat, only one shows a longitudinal weak ridge. The concaved facet for the contact with the sacral rib is large and extends downwards to the level of the lower surface of the centrum. In one of the specimens, part of the rib is still in connection with the centrum.

**Caudal vertebrae.** The number of the caudal vertebrae is very difficult to estimate. According to the reconstruction of *Erythrosuchus africanus* the number of the caudal vertebrae is about 45 but in the plate

8 it looks much less in number. I have the impression that the heavily bodied *Shansisuchus shansisuchus* is very unlikely to have a long tail. This asumption is supported by the relatively poor preservation of the caudal vertebrae. Compared with nearly 200 presacral vertebrae we have only about 45 caudal ones. The caudal vertebrae are isolatedly found and their real connection is not quite certain. They are distinctly much constricted as in the case of *Erythrosuchus*. They are weakly amphicoelous to platycoel, presumably the former ones belong to the anterior part of the tail. The ventral side is compressed or even with rather sharp ridge. The rim of the both ends in uniform and thin, suggesting that the chevrons are much poorly developed. Only a few vertebrae with part of the neural arch preserved show that the diapophysis is short and small. All the preserved caudal vertebrae represent probably the anterior and middle part of the tail, the distal part of which is apparently missing (Fig. 24, G-J, p. 26).

The ***ribs*** are in much fragmentary conditions. Only a few are better preserved. Since we have more than one form in the collection it is impossible to distinguish the fragments as regarding to their specific belongings.

No sure presence of the ***neck ribs*** (Fig. 25, p. 28).

From V.2501 (NWC. E) there is a complete left rib apparently belonging to the nineth or tenth presacral vertebra (Fig. 25, j). The capitulum is short and small. The beam is rather straight with a faint groove at the anterior convex side at the middle portion. The posterior inner side is concave. Distally near the end the bone is somewhat thickening and nearly round in cross-section. Length, 480 mm; distance from tuberculum to capitulum, 88 mm; breadth at the middle 26 mm. Since this rib belongs to the largest individual we can use the size for sorting the other ribs described below:

The other ribs are given in figure 25. Those belonging to the anterior part of the dorsal region are K. P. R. and the others are more posterior in position. The capitulum tends to decrease in size posteriorly and moved close to the tuberculum and finnally disappeared. It is difficult to distinguish the ribs of *Shansisuchus shansisuchus* and the similar sized *Fenhosuchus cristatus* to be described below. But it seems that the more flated and the strongly grooved ones may be considered as belonging to the latter form. The much smaller ones as shown in figure 25, L. M. N. etc. may belong to *Shansisuchus heiyukouensis*.

In all the observed ribs there is no clear trace of the presence of the third articulation as that of *Vjushkovia,* except the only doubtful one (Fig. 25, V). In this spbecimen, the smaller facet may be considered as the third articulation but the proper tuberculum is missing. It is more probably that it represents an abnormally developed rib.

There is no clear trace of the ribs of the caudal region. Some of the fragments may represent the gastral elements.

The ***sacral rib I*** Is a thick bone with roughly quadratic outline (Fig. 25, A-F). The contact surface with the sacral vertebra is shorter than that with the ilium and dividable into two parts. In both facets the sub-divided parts are bending in an obtuse angle for fitting with the corresponding parts of the sacral vertebra I and ilium respectively. They are considerably thickened, so that the whole bone is thinner and concave in the middle part at both sides. The upper lateral border is straght and marked also by a rough surface. Probably there are some cartilaginous tissues existed. The inner lower border is smooth and strongly curved in contrast to the nearly straight or weakly concaved border described above. The size of sacral vertebra I varies considerably, but the general features remain the same. The right one of 60116 (Fig. 22, C) is especially characteristic for the thickening of all the facets and its size takes about the middle position in our collection.

In contrast to the rich representative of the first sacral rib. I, the second one is quite dubious. In

**Table 6. The principal measurements of the vertebrae and ribs (in millimeters)**

| Vertebrae | Ventral length | Anterior breadth and height | Posterior breadth and beight | Total height from the lower posterior border of the vertebra to the tip of the dorsal spine | Length and breadth of the dorsal spine |
|---|---|---|---|---|---|
| Neck: | | | | | |
| 20, A* | 13 | 55×60 | 54×58 | 129 | 70×12 |
| 20, B | — | — | — | — | 83×16 |
| 20, C | 18 | 53×21 | 51×25 | — | — |
| 20, D | 21 | 46×45 | 47×52 | — | — |
| 20, E | 25 | 51×57 | 50×56 | — | — |
| 20, F | 25 | 58×61 | 62×59 | — | — |
| 20, G | 37 | 65×66 | 62×62 | — | — |
| 20, H | 32 | 69×54 | 64×55 | — | — |
| 20, I | 36 | 50×58 | 60×65 | — | — |
| Dorsal: | | | | | |
| 21, A | 52 | 80×78 | 80×77 | — | — |
| 21, B | 51 | 81×73 | 76×76 | — | — |
| 21, C | 58 | 80×74 | 81×73 | 181 | 21×23 |
| 21, D | 49 | 76×70 | 72×69 | 183 | 43×14 |
| 21, E | 58 | 66×68 | 60×58 | — | — |
| 21, F | 61 | 67×70 | 60×68 | 165 | — |
| 22, 14 | 39 | 58×53 | 65×53 | — | — |
| 22, 15 | 44 | 55×50 | 56×48 | — | — |
| 22, 16 | 40 | 57×52 | 55×50 | — | — |
| 22, 24 | 54 | 52×51 | 51×50 | — | — |
| 22, 25 | 50 | 52×50 | 53×49 | — | — |
| 23, A | 45 | 65×73 | 63×70 | — | — |
| 23, B | 44 | 61×65 | 64×58 | — | — |
| 23, C | 47 | 58×61 | 52×64 | — | — |
| 23, D | 45 | 63×65 | 64×62 | — | — |
| 23, E | 38 | 53×62 | 58×60 | — | — |
| 23, F | — | — | — | — | 40×10 |
| 23, $G_1$ | 51 | 56×62 | — | — | — |
| 23, $G_2$ | 53 | — | — | — | — |
| 23, H | 56 | 49×50 | 52×48 | 126 | 37×11 |
| 23, I | 55 | 53×54 | 52×58 | 143 | 41×12 |
| Sacral vertebrae: | | | | | |
| 24, A | 65 | 73×66 | 55×56 | ?130 | 24×?10 |
| 24, B | 49 | 54×46 | 42×39 | ?85 | ?17×9 |
| 24, C | 46 | 66×52 | 40×40 | — | — |
| 24, D | 44 | 69×45 | 44×39 | — | — |
| 24, E | 55 | 35×42 | 36×36 | — | — |
| 24, F | 53 | 42×40 | 34×27 | — | — |
| 22, Sa, 1 | 51 | 56×50 | 41×38 | — | — |
| Caudal vertebrae: | | | | | |
| 24, G | 62 | 78×67 | 70×67 | — | — |
| 24, H | 47 | 58×58 | 48×49 | — | — |
| 24, I | 50 | 42×56 | 42×56 | — | — |
| 24, J | 51 | 54×49 | 51×46 | — | — |

* Refer to the text-figure in the Chinese text, f.i. 20, A means text-figure 20, A and so on.

| Sacral rib I: | Breadth | Medial height | External height |
|---|---|---|---|
| 25, A | 110 | 86 | 113 |
| 25, B | 102 | 89 | 101 |
| 25, C | 68 | 58 | 72 |
| 25, D | 66 | 43 | 66 |
| 25, E | 90 | 70 | 93 |
| 25, F | 70 | 64 | 78 |
| 22, CSa. I | 91 | 73 | 86 |
| Sacral rib II: | | | |
| 25, G | 69 | 40 | 60 |
| 25, H | 63 | 36 | ?47 |
| 25, I | 60 | 42 | 59 |

fact there is no single sacral rib II found in natural connection with either the corresponding vertebra or the ilium. Some isolated bones may be interpreted as such and they are quite different in details (Fig. 25, G-I). We tentatively refer the narrow and elongated facet for connection with ilium. The other end is strong and triangular oval in outline and is evidently for the contact with the second sacral vertebra. The mentioned facet for the ilium fits with the trough of the posterior lower border of the ilium.

## Pectoral girdle and anterior limbs

Most of the pectoral girdles and anterior limb bones are doubtlessly referable to the present form, although a few may belong to other species described below. Those with the thinner and more slender articulations are apparently belonging to younger individuals rather than of systematic value.

**Scapula.** Comparing with the scapula of *Erythrosuchus* and *Vjushkovia* the same bone of our form is at once characterized by its sharp middle constriction and consequently the much more expanded distal end. In the adult individuals the proximal end is very thick, more than three times thicker than the coracoid border. The part above the coracoid border is moderately concave. Then the bone is suddenly constricted but almost immediately begin to expand distally, so that the curvature between the lower anterior proximal end and the upper anterior angle of the distal end forms almost an arch of semicircular outline. The posterior border is almost straight except the part immediately above the articulation end of the humerus which forms a strong posterior projection. The articulation surface of the humerus is thick in adult individuals and with concave part at the middle in younger ones. In the specimens referred to this species, the proximal part is less expanded than that of the distal end or at least equal in breadth. The coracoid border is somewhat triangular in outline. It thins out and passes gradually anteriorly to the part for the contact with the clavicle. The distal part is plate-like but the end is generally rather thick in adult specimens. Looking anteriorly the bone is moderately bent at the part of the constriction (Fig. 26, A—E, p. 30).

**Coracoid.** This bone is very similarly built as in *Erythrosuchus*. It is triangular in outline with the lower ventral border semicircularly rounded. The scapular border and the articulation with the humerus are very thick corresponding to those of the scapula. The lower ventral border is also thick but thins out abruptly anteriorly. The external side is rather flat while the medial side is deeply concave. The coracoid foramen is well formed but comparatively small. It is situated about 20 mm below the scapula border but is open at the medial side and very faint (Fig. 26, A. F, p. 30).

As noted above it is not always sure to distinguish the pectoral bone between various forms in our collection. Those referred tentatively to the other forms will be described below.

**Clavicle and interclavicle.** The presence of these two bones of the present species is not sure.

But the two bones figured in Fig. 25, W and X may represent the proximal part of *clavicle.* It is apparently less curved than that of *Vjushkovia.* The specimen given in Fig. 25, X is much larger and the inner surface is more flat (56156, V.2496) and fits in size with the present species. The other one (Fig. 25, W) is smaller and thinner with the inner side more concave. It may belong to the other species of the genus or a rather younger individual (p. 28).

Two bones illustrated in Fig. 25, Y and Z represent the better preserved specimens of ***interclavicle.*** The posterior part is broken and the anterior end is also damaged. We refer tentatively these two bones to the present species because the size seems to be rather small for *Shansisuchus shansisuchus,* unless of younger individuals. This is especially true for the specimen with the posterior part better preserved. Very curious is that the overturning of the lateral part in the anterior end is not symetrical in both specimens. The constriction is rather weak and seems expanding only very gently posteriorly.

**Humerus.** Most of the humeri of our collection belong to the present species. The both expanded parts are only moderately twisted about 30 degrees. The beam is also flat. The narrowest part of the bone lies approximately at the middle or slightly below. The proximal part is much expanded and the deltoid crest extends a distance higher above the middle of the bone. In adult specimens the articulation part is conspicuously thicker. The proximal part is moderately arched especially along the deltoid crest. The distal part is also strongly expanded although somewhat narrower than the proximal end. The depression above the distal end at the antcrior ventral side is deeply excavated, except in young specimens. There is

**Table 7. Principal measurements of the pectoral girdle and anterior limbs (in millimeters)**

| **Scapula** | Max. length | Proximal breadth | Distal breadth | Minimum breadth of the middle |
|---|---|---|---|---|
| | 265—320 | 115—150 | 139—173 | 49—58 |
| **Coracoid** | | | | |
| Maximum distance from upper end of the scapula border to the lower end of the humerus border | | | | 106—127. |
| Length of the scapula border | | | | 70—100. |
| Thickness of the humerus border | | | | 50—65. |
| **Clavicle** | | | | |
| Proximal breadth | | | | 30 (sp. 25, W.); 44 (sp. 25, X.). |
| **Interclavicle** | | | | |
| Total length | | | | ?220. |
| Anterior breadth | | | | 40. |
| Minimum breadth | | | | 28; 35. (25, Y.) |
| **Humerus** | | | | |
| Total length | 255 (27, A.) | 212 (27, B.) | 257 (27, C.) | 290 (27, D.) |
| Proximal breadth | 153 (27, A.) | 128 (27, B.) | 148 (27, C.) | 181 (27, D.) |
| Distal breadth | 110 (27, A.) | 97 (27, B.) | 128 (27, C.) | 133 (27, D.) |
| Minimum breadth | 45 (27, A.) | 42 (27, B.) | 45 (27, C.) | 57 (27, D.) |
| Length of the deltoid crest | 103 (27, A.) | 85 (27, B.) | 107 (27, C.) | ?138 (27, D:) |
| **Ulna** | | | | |
| Length | | 198 (28, A.) | | 220 (28, B.) |
| Maximum proximal breadth | | 70 (28, A.) | | 82 (28, B.) |
| Distal breadth | | 45 (28, A.) | | 47 (28, B.) |
| Minimum breadth and thickness | | 29×14 (28, A.) | | 27×18 (28, B.) |
| **Radius** | | | | |
| Length | | 152 (28, C.) | | 186 (28, E.) |
| Proximal breadth | | 48 (28, C.) | | 51 (28, E.) |
| Distal breadth | | 51 (28, C.) | | 62 (28, E.) |
| Minimum breadth at the middle | | 18 (28, C.) | | 23 (28, E.) |
| Ratio of Radius: Humerus | | 255: 152 = 59 | | 257:186 = 68 |

no foramen ectecondyloideum, although a groove may be seen in the specimens of younger individuals. In the younger specimens the condyles are poorly developed and the whole bone is extremely thin. Yet, the general shape and the degree of twisting are exactly the same as those of the adult ones. On the whole the humer of *Shansisuchus shansisuchus* are easily distinguishable from those of other forms in our collection. The deltoid crest is less downward extended than that of *Erythrosuchus* and *Vjushkovia* (Fig. 27, A—D, p. 31).

**Ulna.** This bone is poorly represented in the collection, only three complete ones and the others are represented by proximal and distal end only. Although it is difficult to determine the bone individually, but it is clear that the length of the ulna is comparatively shorter than both of *Erythrosuchus* and *Vjushkovia.* In the two mentioned forms the ulna is only slightly shorter than the humerus while in our form the ulna takes scarcely two third of the length of the humerus. There is no trace of olecranon. The proximal end is very thick with triangular outline. It is weakly convex or nearly flat. The shape of proximal end is rather variable, due chiefly to the more or less extension of the posterior medial projection. The bone becomes narrow and thin distally and the minimum part lies quite near the distal end. Then the bone begin to expand again in order to form the rather solid end with the oval rounded end surface. The part of the minimum constriction is so thin that it is very easy to break at this place. The beam is straight but may be somewhat S-shape curved in rather younger specimens (Fig. 28, A—B, p. 32).

**Radius.** The radius is about the same length as that of the ulna or may be slightly shorter. Its proximal end is oval rounded and moderately expanded. The minimum constriction lies about the middle of the beam which is very weakly S-shaped curved. The distal end is more expanded. The richness of the broken proximal and distal ends show that the size is very variable due chiefly to the age. However the smaller specimen may be regarded as belonging to the other smaller species of the same genus (Fig. 28, C—E, p. 32).

## Pelvic girdle and posterior limbs

The pelvic girdle is completely preserved, although only a few are ones. The best preserved one is that of V.2501 which shows the three elements of the same individual (Fig. 29, 30, p. 33, 34).

**Ilium.** The ilium is very similarly formed as in that of *Erythrosuchus.* The anterior extension is very weak and scarcely before the anterior border of the acetabulum, while the posterior extension is much longer with thickened rod-like end. The upper border between the anterior and posterior ends forms a moderate curvature with, however, the posterior end especially projecting. The acetabulum is apparently closed (See below) with the upper border sharply crested and overhangs externally. The pubis border is much shorter than the ischium border. The two borders form an obtuse angle. In the medial side the bone is more or less convex at the part opposing the acetabulum. The impressions of the first and the second sacral ribs in many specimens are very clear. That of the second sacral rib started higher above the first one and narrows posteriorly and vanishes above the lower border of the posterior extension. The constriction between acetabulum and the ilium plate is about the length of the pubic border. The plate itself is for the most part rather thin and easily broken away. The specimen with the acetabulum quite differently constructed is evidently belonging to another form and will be described later. On the whole, most of ilia are referable to the present species.

**Pubis.** The pubis is also similar to that of *Erythrosuchus* in general features. But the pubis foramen of our form is more marginally situated and formed as a notch extending to the ischium border. It is almost closed but the bone there is well separated. In both *Erythrosuchus* and *Vjushkovia* this foramen is

entirely closed and lies a distance from the ischoum border. In our collection from 56173 there is a single pubic with the pubic foramen closed (See below). But since most of the pubic are with this foramen marginal and not entirely closed and the same is found in the complete pelvic girdle of V.2501 which is certainly belonging to this species, we must consider that this sort of pubis should be attributed to the present form.

The pubis is extremely short, the length is only slightly exceeding the breadth. In the specimens of approximately young forms (may possibly belonging to the second species) it is relatively longer. The contact surface of the ilium and the contact surface near the ischium form the thickest proximal end of the bone. The contact surface with opposite one is thinner. The distal end is almost truncated or weakly curved. There is a very weak constriction at about the middle of the bone with a right angle bending below the ischium border. The distal part below the mentioned constriction is plate-shape with the posterior external part thicker. The bone is peculiarly arched between the both ends so that the anterior lateral side is convex and the medial posterior side concave. In the younger specimens a distinct ridge may be observed between the medial side of the distal end and posterior part of the pubis foramen.

**Ischium.** The ischium is also similar to that of *Erythrosuchus* and different from that of *Vjushkovia.* It is short and broad. The contact with the ilium is observable in the adult specimens. It is marked often by a faint ridge from the part making the portion of the acetabulum. The whole end is cresent in outline. The bone is plate-shaped below the proximal end and makes a thin and rounded prolongation medially and anteriorly. Then it is suddenly constricted as a distinct notch about two third of the whole length of the bone exactly as in the case of *Erythrosuchus* and scarcely indicated in *Vjushkovia.* In the external view the notched part forms a groove extending posteriorly and upwards. Posterior to this groove another accessory much fainter groove may be formed, especially clear in fully grown specimens. The distal part of the ischium is more or less thickened with a blunt end. In the inner view the part between the proximal and distal ends is marked by a shallow depression separated by a oblique ridge just opposing the groove of the other side. All these features of the ischium from the locality 56173 are agree in essential with the complete one from Ningwu (V.2501) so that there is no doubt that they all belong to the same species. The pelvic girdle of V.2501 represents a large and adult individual and the above mentioned groove at the external side is less clear.

**Reconstruction of the pelvic girdle.** In all the preserved elements of the pelvic girdle there are no two bones found together with the exception of the right ilium and right ischium and the left pubis of V.2501 which are certainly belonging to the same individual. This gives us a possible idea of the whole view of the pelvic girdle which is given in Figure 30, B. It shows clearly that although the pelvic girdle of our form is similarly built as in the case of *Erythrosuchus* but differs considerably from that of the above mentioned form in many aspects. In the pelvic girdle of the present form the anterior process of the ilium is almost negligible (about the same as that of *Vjushkovia*), and the pubis contact is relatively small and almost continuously passing to the border of the ischium without noticeable separation. Both the pubis and the ischia are very short. The pubis foramen is situated marginal and open. Furthermore the total length of ischium and pubis is subequal and considerably shorter than the length between the anterior and posterior processes of the ilium while in both of *Erythrosuchus* and *Vjushkovia* the case is just reverse. As seen in the given figure both the pubis and the ischium take comparatively a small part (less than one third) for making the acetabulum. The joint border of the both bones of the ilium is not angular about a right angle as in the case of other forms but almost a continuous gentle curvature. The pubis border is comparatively longer. The most interesting point is, (as shown in the given figure and also during the mounting of the

skeleton chiefly composed of V.2501, 56173 and the pelvic girdle belongs to one individual from 60116) that the three bones of the pelvic girdle cannot fit exactly together. It seems that the acetabulum is not completely closed. It must be noted also that the reconstruction given by Broom and copied by v. Huene (1911, p. 22, Fig. 10) may be somewhat artificial, as in the other mounting skeleton of the same species (*ibid,* pl. VIII) the acetabulum is also not quite closed. In any way the pelvic girdle of our form is characteristic for itself and differs considerably from that of the other related genera.

**Femur.** As in the case of the humerus, the femur is represented by specimens of various age and thus different in details. But the general features are essentially the same. In general, the specimens of younger individuals are marked by the rather or quite thin condyles of both ends and more slender beam. The complete left femur and the both ends of the right one of 60116 are rather adult and comparable with most of the better preserved specimens of 56173 (Fig. 31, p. 36).

As in the case of *Erythrosuchus* the both ends of the femur are marked by a more or less distinct groove suggest that they were covered by cartilaginous material during life but less developed as in that of the named form. In our collection this is especially distinct in quite younger forms and less clear in older ones, although it is in general observable. In a few cases it is disappeared completely. The whole bone is straight and not S-formed curved. The both ends are only moderately widened. The proximal end is slightly broader than the distal end in adult specimen but may be reverse in younger ones. The both ends are twisted slightly as compared with that of the following described form, about less than 30 degrees. The proximal condyle is more or less well formed and looks rather small for the large acetabulum of the pelvic girdle. The condyle narrows gradually laterally in connection with the not very distinctly differentiated lesser trochanter. In younger specimens, the both sides are more or less depressed. The fourth trochanter is not well developed but can be observed faintly in most cases. It is situated not far from the proximal end and well above the middle of the shaft. The minimum breadth of the shaft lies some distance below the middle point of the bone and is transverselly somewhat expanded, the transversal breadth exceeds that of the anterio-posterior one. The distal expansion is generally less than the proximal one, but in younger specimens the distal breadth may exceed that of the proximal one. The distal end is rectangular in outline, but in less adult specimens the tibia condyle may project distinctly medially. Both in anterior and posterior side above the both condylii there is a more or less well formed depression which is especially well developed in younger specimens. A faint groove may also be formed above the distal end both laterally and medially, although vanished almost completely in older individuals.

**Tibia.** The tibia is rather poorly represented, only two being complete from 56173. The proximal end is rather thick and the proximal end is rounded triangular in cross-section with the anterior angle very blunt. The proximal end is higher at the medial side and slopes laterally. Externally below the proximal end there is a distinct depression but less so in some other specimens. The bone becomes narrower distally in abrupt way and then gradually in order to form the rather slender shaft which is transversally compressed. From the lower middle part the bone becomes broader again for making the moderately broad distal end which is of course less expanded as the proximal end. The distal end is transversally elongated rounded in outline. On the whole the tibia is slender and very similar to that of *Vjushkovia.* There is no single tibia found together with the femur so that the relative length of the two bones remains unknown. Taking however the specimens of both about the same age it is rather clear that the tibia is considerably shorter than the femur, much shorter than that of the named genus. We shall come back to this point later (Fig. 32, A—B, p. 37).

**Fibula.** As in tibia the fibula is also a very slender bone. It is very weakly S-shaped bent. The

both ends are only moderately expanded and sub-equal in breadth, the distal end being somewhat more thick. In the specimens of younger individuals they are rather thin. There is a distinct furrow at the medial side of the shaft which vanishes towards both ends. The poorly developed trochanter at the external side is located almost just below the middle point of the shaft. As there is no single bone found together with tibia and femur, the real relative length of the fibula cannot be said. But it is very likely that it is somewhat longer than the tibia. The fibula of V.2501 is the longest one among the collection, much longer than the tibiae at disposal, suggesting that the skeletons of the large individuals are missing in 56173 (Fig. 32, C—G, p. 37).

**Table 8. Principal measurements of the pelvic girdle and posterior limbs (In millimeters)**

| | |
|---|---|
| **Ilium.** | |
| Anterior -posterior length of the blade | 223 (V. 2501); 167 (an unfigured specimen, 56173) |
| Minimum breadth above the acetabulum | 78 (V. 2501); 56 (an unfigured specimen, 56173); 68 (29, A); 60 (29, B.) |
| Breadth of the acetabulum | 140 (V. 2501); 98 (an unfigured specimen, 56173); 131 (29,A); 118 (29, B.) |
| **Ischium.** | |
| Length | 186 (V. 2501); 176 (29, C.); 138 (29, D.) |
| Maximum breadth | 176 (V. 2501); 146 (29, C.); 136 (29, D.) |
| **Pubis.** | |
| Length | 195 (V. 2501); 158 (29, E.); 139 (29, F.) |
| Maximum breadth | 111 (V. 2501); 99(29, E.); 79 (29, F.) |
| **Femur.** | |
| Length | 322 (31, A.); 316 (31, B.); 310 (31, C.) |
| Proximal breadth | 102 (31, A.); 110 (31, B.); ?73 (31, C.) |
| Distal breadth | 97 (31, A.); 88(31, B.); 100 (31, C.) |
| Tranversal and sagital breadth of the beam | 35×34 (31, A.); 35×32 (31, B.); 33×?30(31, C.) |
| **Tibia.** | |
| Length | 255 (32, A.); 255 (32, B.) |
| Proximal transversal and sagital breadth | 72×57 (32, A.); 79×51 (32, B.) |
| Minimum transversal and sagital breadth of the shaft | 27×19 (32, A.); 29×20 (32, B.) |
| Distal transversal and sagital breadth | 56×35 (32, A.); 55×41 (32, B.) |
| **Fibula.** | |
| Length | 320 (32, C.); 265 (32, D.); 230 (32, E.); ?200 (32, F.); 185 (32, G.) |
| Proximal breadth | 51 (32, C.); ---------- 50 (32, E.); ?32 (32, F. ); 38 (32, G.) |
| Distal breadth | 51 (32, C.); ----------; 48 (32, E.); 38 (32, F.); 27 (32, G.) |

## Hand and foot bones

All the elements of the hand and foot bones are extremely rare in our collection. In nearly fifty individuals of the present species, it is hardly to make a whole set of the composite hand and foot. Among the present elements, duplicate specimens are exceedingly rare except the calcaneum. Since the hand and foot bones are poorly known and many forms are represented in our collection, the exact determination is very difficult. Therefore the identification made below may be rather subjective and conjectural.

**Carpets.** There is no ***ulnare*** and ***radiale.*** The carpals of the distal row may be represented by a few ones as illustrated in Figure 33 E to H, presumably of plantar views. It is possible that the E may represent the first and F the centrale, G the fourth carpalia and H the second carpalia respectively. They are all irregularly shaped and the ossification may not be complete (Fig. 33, E—G, p. 38).

**Metacarpals.** With the exception of the distal part of Mtc. II, III and IV adhering still to part of their phalanges which pertain to one individual, all the other metacarpalia were found isolatedly. Those given in Figure 33 A are considered as the right metacarpalia and B metacarpalia as the left tentatively. The Mtc. I is extremely short and broad. The following ones are also comparatively short. Mtc. V is.

only represented by the right side with the distal end damaged and comparatively slender and smaller. In all of them the proximal ends are transversally elongated (Fig. 33, A—B, p. 38).

**Phalanges.** All the isolated phalanges including the terminus one (the claw) are referred to the pes and therefore no sure presence of it for the hand. Yet, the above-mentioned specimen figured in Figure 33 D include phalanges 1 and 2 of Mtc. I; 1 and 2 of Mtc. II; 1 of Mtc. III and 1 of Mtc. IV of the left side. They decrease in size and robustness abruptly laterally. The claw of the first digit is massive and short and sharply compressed and pointed. Otherwise they are built in ordinary way and need not to mention specially (Fig. 33, D, p. 38).

On the whole the manus is rather primitive as indicated by the less long stretched metacarpals.

**Tarsals.** The tarsal bones are better preserved.

**Astragalus or tibiale.** The better preserved astragalus is represented by two left specimens shown in Figure 34 A and B. The two considered as belonging to the present form are quite different in details but most probably to the same species. The bone is so oriented that the concave side with the prominent oblique ridge separating the two rather flat areas as upper or dorsal side while the transversally convex surface the lower or the ventral side. The thick rounded end is the lateral side while the boader dorso-ventrally compressed side is the medial side. The end of the former is weakly convex and fits very nicely with weakly concave medial end of the calcaneum. It passes superiorly and forms another smaller oblique surface which also fits with the opposite one of the calcaneum. The medial end is convex. There is a distinct transversal groove on the ventral side. The medial flat surface for the contact with the Mtc. I and the lateral concave surface probably for the receiving of the medial distal tarsal. At the lateral part of the anterior side near the lateral end there is a concave surface undoubtedly corresponding to the anterior concave surface of the calcaneum. In posterior view, a second oblique ridge starting from the upper posterior and lateral corner, running medially and downwards to the ventral side about one third to the medial end. This separates the deeply excavated small depression on the lateral side and the rough surface at the medial side. When view from anterior or posterior side the faintly L-shaped outline of the astragalus can be seen as indicated by the high articulated surface in connection with the calcaneum described above. This is for the articulation with the fibula while the tibia surface lies medially to the oblique ridge. On the whole it seems that the general shape of the astragalus foreshadows already that of the primitive dinosaur although the ascending process in our form is rather differently constructed (Fig. 34, A—B, p. 39).

**Calcaneum or fibulare.** More than thirteen calcaneums are referred to the present species, five of them are figured in Figure 35, A—E. They are quite different in size and structure as for instance the thickness etc. But their general shape remains the same, so that they belong most probably to the same species. The orientation of the calcaneum is to consider the weakly concaved side as the anterior or dorsal and the saddle-shaped convex side as the posterior or ventral. The broad and thick end with the weakly concaved surface of the central part faceing the lateral side of the astragalus is the medial end while the less broad semi-circular end as lateral side. Both ends vary considerably in broadness as shown in the given figures. The upper side is rather thick and straight for the articulation with the fibula. The ventral side is thinner and sometimes weakly concave. The two convex part of both ends are in connection with the lateral and medial part of the distal tarsal. The calcaneum is comparatively small, especially its transversal breadth is much shorter than the astragalus. On the whole the calcaneum is still plate-shaped and primitive more comparable with primitive reptiles as in the case of *Erythrosuchus* (Huene, 1915, 1920) than with that of the armored pseudosuchians (Sawin, 1947 and Walker, 1961) and crocodilian tarsus (Schaeffer, 1941). The present calcaneum differs only slightly from that of *Erythrosuchus* so that its closest

affinity with named form is obvious (Fig. 35, A—E, p. 40).

**Distal tarsals.** The distal tarsals are represented by thirteen specimens. They are all irregularly ball-shaped with one or two flat surfaces. They vary also greatly in size (greatest diameter 33 to 62 mm). Since they are all found isolatedly it is difficult to distinguish their exact position. However, the smaller ones may be of the middle or medial ones and the larger the lateral ones. The cross-sections have been made showing the dense structures of bony cells with a distinct ossification center.

**Metatarsals.** All the better preserved metatarsals are given in Figure 36. In addition there are some fragments of the same, chiefly by proximal and distal end. There is no complete left Mt. IV but fortunately a proximal end of Mt. IV with considerable portion of the beam in association with the Mt. V belonging to the same individual is known. The metatarsals are also short and broad as in the case of the metacarpals. Mt. I is longer in comparison with Mt. I. Mt. II—IV differ from those of the metacarpals by their less constriction of the beam. Mt. V is distally hooked with the proximal end very broad as in many pseudosuchians (p. 41).

**Phalanges.** The arrangement of the phalanges shown in Figure 36 is extremely conjectural as all of them were found isolatedly and thus only arranged according to size and form. Nevertheless, it may show the general sequence and structure not far from the truth. The first phalanx of Mt. I is more robust and broad. The following ones are comparatively slender. The first phalanx of Mt. V is much smaller and slender. This digit is evidently reduced and tends to be vestigial. The claw or the terminal phalanx is apparently present in all the digits. The first one is the largest and the strongest, decraing considerably laterally. and sharply compressed and pointed. Very interesting is that in all of them a more or less distinct notch is developed at the ventral side near the proximal end. The number of the phalanges is most probably 2, 3, 4, 5 and 3.

**Table 9. Measurements of the hand and foot bones (in millimeters)**

| | Mtc. I | | Mtc. II | | Mtc. III | | Mtc. IV | | Mtc. V. | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Metacarpals* (fig. 33) | L. | R. | L. | R. | L. | R. | L. | R. | L. | R. |
| Length | 41 | 38 | 53.5 | 47 | 55 | 47 | 42 | 34 | — | 31 |
| Proximal breadth | 33 | 33 | 28.5 | 34 | 43 | 42 | 29 | 29 | — | 27 |
| Distal breadth | 24 | 24 | 21.5 | 26 | 30 | 30 | 17 | 23 | — | 8 |

| **Astragalus** | Specimen 34, A | Specimen 34, B | sp. 34, C[1] | sp. 34, D[2] |
|---|---|---|---|---|
| Breadth | 68 | 57 | 52 | 37 |
| Height and anteroposterior length of the lateral end | 35×29 | 25×24 | 43×30 | 20×13 |
| The same of the medial end. | 13×44 | 23×43.5 | 27×41 | 12×28 |

| **Calcaneum** | Sp. 35, A | Sp. 35, B | Sp. 35, C | Sp. 35, D | Sp. 35, E | Sp. 35, F[3] |
|---|---|---|---|---|---|---|
| Transversal breadth | 45 | 38 | 42 | 45 | 42 | 45 |
| Medial height and length | 33×30 | 24×28 | 31×30 | 26×27 | 20×28 | 38×43 |
| Lateral height and length | 27×36 | 18×33 | 19×32 | 20×39 | 11×33 | 28×45 |

| Metatarsals (Fig.36) | Mt. I | | Mt. II | | Mt. III | | Mt. IV | | Mt. V | |
|---|---|---|---|---|---|---|---|---|---|---|
| | L. | R. | L. | R. | L. | R. | L. | R. | L. | R. |
| Length | 59 | 50 | 60 | 66 | 61 | 58 | — | 53 | 48 | 47 |
| Proximal breadth | 47 | 37 | 48 | 46 | 35 | 42 | — | 40 | 44 | 39 |
| Distal breadth | 28 | 25 | 30 | 23 | 24 | 24 | — | 27 | 11 | 12 |

Proximal breadth of the left Mt. IV 35, C··········39 and of Mt. V 44.

(1) Calcaneum of *Fenhosuchus cristatus*, see below. p. 39.
(2) Astragalus of *Wangisuchus tzeyii*, see below. p. 39.
(3) Right calcaneum of *Fenhosuchus cristatus*, see above, p. 40.

If the arrangement of the phalanges is not far from the truth, it is obvious that the length of the phalanges exceeds considerably that of the metatasalia. The shortness of the metatasalia with much longer (probably also in the manus) phalanges is undoubtedly a primitive character. The general appearance of the foot recalls that of procolophonids, *Trilophosaurus* and *Sphenodon,* especially the latter two in which the fourth digit is longest and the proximal end of Mt. V is much expanded.

On the whole the anterior and posterior feet of *Shansisuchus shansisuchus* is primitive in nature as in other postcranial skeletons. The feet must lay nearly on the surface and hardly fit for swift running instead of the carnivorous dentition and skull.

## Reconstruction and different proportions of the skeleton

As repeatedly noted above that most of the post cranial bones were found in amazingly confused way and disarticulated. Thus, it is very difficult to identify their individual belongings. Nevertheless attempt has been made to make some reconstruction of part of the better preserved vertebrae and limb-bones in order to get some fairly reliable idea about the whole picture of the animal. In doing so, the remains of the other localities besides that of Hsishihwa, Lotzeyue, Wuhsiang (56173) have been used, including those from Ningwu and Shinghsien as the materials from the locality 56173 are not enough for making several skeletons. So far as possible, of course, the better specimens are used first for this purpose, especially the figured specimens. Needless to say that such attempt is only a suggestive one. The order of the individual vertebra and its exact position are quite conjectural. The different degree of maturity of some limb-bones were sometimes certainly put in one skeleton and so on. In short, the present reconstruction of skeleton made is not only a composite but a very provisional one and need further improvement. As shall be discussed below the result of the reconstruction is quite satisfied as it shows nevertheless a life picture instead of such poor preservation of the specimens.

The most isolated vertebrae are only sufficient for seven sets nearly complete columns, the tail being nearly wanting. The better limb-bones only three, the others are fairly good for making partial plaster or panel mountings. The following three standing posture of reconstruction were made by our technicians Mr. Y. L. Sou and Mr. K. T. Li under my supervision.

1. To the type skull V.2503 we attribute the following bones: nearly complete vertebrae from neck to middle caudal, nearly complete anterior and posterior limbs all from 56173. Many of the figured specimens are mounted in this skeleton. With the exception of the most spina dorsalis which are missing, all the other bones are fairly complete. The hand and foot are made of the data of the specimens illustrated in Figures 33 and 36. In this skeleton most of the vertebrae and limb-bones represent certainly a mature individual, same as the skull. This is the only skelcton mounted of which all the bones were used exclusively from the locality 56173.

In this mounting a few vertebrae and part of the limbs, especially the both scapulae, coracoids and humeri are less adult in age for possessing more nicely with the skull and other skeletons. Otherwise it is fit in general for a composite mounting.

2. In the second mounting attempt has been made in using chiefly the skull from 56173 (V.2506) and the well preserved limbs certainly of one individual, from Heiyuekou, Shinghsien (V.2513) (the only fragment of the maxilla is not used). The missing parts, anterior part of the skull, the lower jaw, most of the vertebrae and limbs are restored by the materials from 56173. Many of the vertebrae are smaller than those of Heiyuekou. The limbs from this locality fit with the skull and the other limb-bones used for completeness. Comparing with the preceding one many parts of the bones are restored or duplicated by plaster.

Hand and foot bones are reproduced from the preceding one.

3. The third mounting is also a composite one. We used the well preserved materials from Ehrmayin as the base and completed it by the specimens from 56173. Since the specimens of V.2501 represent a very adult individual the vertebrae from 56173 used for this mounting look also too small in comparison with the vertebrae of V.2501. The same holds true for the left humerus and some other bones. This difference is 'however' not so much as concerning the maturity rather than the individual variation. There is also no hand and foot bones preserved we copied them from the first one for completeness.

The panel mounting will not introduced here before they are really made. In all the reconstructions the middle and posterior parts of the tail are missing. One can complete it by paper reconstruction as given in Figure 37 for the first skeleton mounted (p. 42).

Although those reconstructions are highly composite in nature as described above, they fit each other remarkably (see plates VI—IX) in general structure. Their general appearance is very similar to the reconstruction of *Erythrosuchus africanus* by Huene so well known and widely copied.

Before discussion in detail the following proportions of the different parts of the skeleton will be given below:

**Table 10. Various ratios of the mounted skeletons**

| | | | |
|---|---|---|---|
| 1. $\frac{\text{Length of the head}\times 100}{\text{Length of the presacral vertebrae}}$ | ca. $\frac{570\times100}{1150}$ | 50 | Skeleton 1. |
| | $\frac{610\times100}{1190}$ | 51 | Skeleton 2. |
| | $\frac{620\times100}{1280}$ | 48 | Skeleton 3. |
| The same of *Erythrosuchus africanus* measured from the reconstruction by v, Huene | | | 57. |
| 2. $\frac{\text{Length of humerus + radius}\times100}{\text{Length of femur + tibia}}$ | $\frac{260-180\times100}{305-250}$ | 79 | Skeleton 1. |
| | $\frac{311-207\times100}{320-288}$ | 85 | Skeleton 2. |
| | $\frac{300-225\times100}{375-320}$ | 80 | Skeleton 3. |
| The same of *Erythrosuchus africanus* measured from the reconstruction by v, Huene | | | 78. |
| 3. Fore/hind limb | $\frac{170+260+180\times100^{*}}{220+305+250}$ | 79 | Skeleton 1. |
| | $\frac{170+311+207\times100}{220+320+288}$ | 71 | Skeleton 2. |
| | $\frac{170+300+225\times100}{220+375+320}$ | 76 | Skeleton 3. |
| 4. Fore limb/presacral vertebrae | $\frac{610\times100}{1150}$ | 53 | Skeleton 1. |
| | $\frac{688\times100}{1190}$ | 58 | Skeleton 2. |
| | $\frac{615\times100}{1380}$ | 54 | Skeleton 3. |
| 5. Hind limb/presacral vertebrae | $\frac{775\times100}{1150}$ | 67 | Skeleton 1. |
| | $\frac{828\times100}{1190}$ | 70 | Skeleton 2. |
| | $\frac{915\times100}{1280}$ | 71 | Skeleton 3. |

* The length of the hand and foot is estimated as 170 and 220 respectively according to the composited hand and foot described above.

In the above given 5 different ratios of the three mounted skeletons, the first impression is that all the figures are quite close to each other. It must be noted that the various bones selected for reconstruction

are really at random to some extent. Specimens were put together even from widely separated regions. Nevertheless, all the results show that the difference is very small. This would reinforce our assumption that they belong really to the same species.

It is also obvious to note how close are the two ratios of *Erythrosuchus* compared with those of ours. Since the hand and foot bones are entirely lacking in the named form, so no ratios were made of the last three but most probably also very near each other. We must conclude that the both genera are closely related to each other. All the skeletons of the other pseudosuchians are widely different from that of ours and need not be considered here.

*Shansisuchus shansisuchus* is certainly a large headed, very plump and clumsy animal with carnivorous teeth. The animal must be a poor runner and defenceless. Nevertheless they are successfully developed and widely distributed during the *Cynognathus*-time of Triassic. Perhaps no other beast can compete with such large animal and some of the large and small cynodonts and other tetrapods of the same time are mostly equally clumsy beings which are easily to be catched, so that such contradictory structure of *Shansisuchus shansisuchus* forms no special shortcoming for live. However, the steady rise of the carnivorous cynodonts threatens undoubtedly the further development and at last the whole extinction becomes unavoidable.

## COMPARISONS AND DISCUSSIONS

During the course of the foregoing description it is obvious that the only thecodonts comparable with the present form are the genus *Erythrosuchus* from S. Africa and the recently described genera *Vjushkovia* (Huene, 1960) and *Garjainia* (Orchev, 1958). The last genus is only so far preliminarily announced. According to the review made by Tatarinov (1961) both the two russian genera and the recently described form *Chasmatosuchus, Vjushkovi* Orchev (1961) and the long known *Dongusia colorata* should all be grouped under the genus *Erythrosuchus*. Before we are going to make a more suggestive classification, it is better to keep them apart in the following table of comparison. Both the remains of *Chasmatosuchus vjushkovi* (A left premaxilla only) and *Dongosia colorata* (A dorsal vertebra only) and thus excluded from the list of comparison. No postcranial bone of *Garjainia prima* (except a few vertebrae) is known and the observations can only be drawn from the much reduced picture; so that their value should be used with much reservation.

In broad sense all the genera given in the above table seem to form a quite natural group in contrast to the more primitive Proterosuchids on one hand and the late pseudosuchians on the other. In all the four genera, the skull is more or less long stretched, upwards directed supratemporal opening, large orbit, large lower temporal opening, more or less vertically directed quadrate, carnivorous teeth and the lower jaw bears large dental foramen except *Erythrosuchus*. In all of them except *Garjainia* of which the post cranial skeleton is not known, the cervical vertebrae are rather and sometimes very short, generally keelless dorsal vertebrae, two sacral vertebrae and the limb bones are rather primitive in nature. It is out of question that they represent a group intermediate proterosuchids and other specialized pseudosuchians.

On the other hand the Chinese form indicates an obvious differences from all the other genera such as the presence of two preorbital openings, even in no single other thecodont possessing two preorbital openings. Nevertheless, I have the strong impression that even *Erythrosuchus africanus* itself may have two preorbital openings. Firstly the left maxilla of Huene's specimen (1911, Pl. IV, Fig. 1) shows clearly a rather posteriorly situated process with a half rounded circular outline same as that of ours. In addition the right premaxilla bears also a process behind the nasal opening. Taking all these in consideration the second preorbital opening may actually present between the nasal opening and the first preorbital opening. It is posteriorly bordered separated by the upper process of the maxilla and anteriorly bordered by the posterior

**Table 11. Important features compared with other related genera**

| Special features | *Shansis. shansis.* | *Erythros.* | *Vjushkovia* | *Garjainia* |
|---|---|---|---|---|
| 1. Ration of the post. maxi. height and total length of the skull. | 270/570 (type) 270/47 | 46 | 41 | 40 |
| 2. Ratio of breadth length of the skull. | 250×100/570 250×44 | 61 | 40 | — |
| 3. Number of preorbital opening | 2 | 1 | 1 | 1 |
| 4. Shape of suprtemporal opening | Triangular, ant. border perpendi. to the axis of the skull, making a slightly obtuse angle with the lateral border. | Anterior border obliquely to the axis of the skull, making an acute angle with the lateral border. | Anterior border obliquely to the axis of the skull, making a very obtuse angle with the lateral border. | — |
| 5. Parietal foramen. | Absent, forming a distinct boss | Present | Absent, with boss | ? |
| 6. Interparietal | With long and prominent posterior process. | Present | Absent | ? |
| 7. Position of the anterior border of the orbit. | A distance behind the frontalnasal suture. | Very near | ?far behind | ? |
| 8. Frontal | Excluded for making part of the orbit border, prefrontal & post-frontal in direct contact. | Not excluded | Taking considerable part of the orbit. | ? same as in *Erythrosuchus.* |
| 9. Frontal-nasal suture | Deeply zigzag and firmly interlocked | Same | ? | ? |
| 10. Nasal. | Long & narrows very gently forwards without distinct middle constriction. | Narrows rapidly forwards with distinct constriction. | Narrows forwards with constriction. | ? |
| 11. Foramen magnum. | Transversally extended. | Nearly rounded. | Transversally expanded. | ? |
| 12. Posterior processes of parietal. | Forming about a right angle. | Same. | Large obtuse angle. | ? |
| 13. Maxilla. | With a supra process a distance from anterior end for separating the two preorbital openings order flat inner corvex. | No. | No. | No. |
| 14. Lower jaw. | Symphysial part more or less thickened and enlarged. | ? | No. | Slightly thickened. |
| 15. Number of premaxillary teeth. | 6 | 5 | ? | ?5 |
| 16. Number of maxillary teeth | ?12 | ?9* | ? | 14 or 15** |
| 17. Number of lower teeth | ?12 | 11* | 8–* | 13 or 14** |
| 18. Neck vertebrae. | Probably ten in number. Short with thickened border and amphicoelous without intercentrum. Height of the anterior ones exceeds the breadth, posterior ones subequal. | The same but with intercentrum Height exceeds breadth. | ?7, more elongated, no intercentrum. | Long and high subequal, no intercentrum observed. |
| 19. Dorsal vertebrae. | Probably 15 in number. Rather short, ventrally keeled in anterior ones. | Same in anterior ones also thickened border. | Centrum not keeled. | ? |

(*Continued*)

| | | | | |
|---|---|---|---|---|
| 20. Sacral vertebrae. | 2 | 2 | 2 | ? |
| 21. Caudal vertebrae. | ?35– | 35– | ? | ? |
| 22. Scapula. | Narrowly constricted in the middle proximal breadth less than the distal. | Same | Proximal breadth more than distal | ? |
| 23. Coracoid. | Anterior border thick, Foramen not perforated and elongated. Comparatively small, trinngular. | Outline foramen far from the border and perforated. | About the same. | — |
| 24. Interclavicula. | Present, very thin, moderately constricted below the proximal part. | — | Sharply constricted below the proximal part. | — |
| 25. Humerus. | Proximal and distal plane moderately twisted, processus lateralis extends downwards a distance above the middle of the whole length, Articular condyle generally not well developed. | Proximal & distal plane sharply twisted, forming a right angle. processus lateralis extends much downwards about the middle of the whole length. | Like *Shansisuchus* | — |
| 26. Ulna. | Olecranon poorly developed, slightly shorter than the humerus. | Same | Same | — |
| 27. Radius. | Proximal end reduced, distal end strongly expanded, slightly shorter than the ulna. | Short and massive with both ends rather expanded. | Same | — |
| 28. Ilium. | Anterior prosess almost absent very obtuse. | Anterior process more prominent. | Anterior end very obtuse | — |
| 29. Pubis. | Slightly shorter than the ischium with the pubis foramen marginal | Same pubis foramen closed | Much shorter than the ischium. | — |
| 30. Ischium. | Plate moderately curved with the posterior medial notch deep. | Same | Almost no notch. | — |
| 31. Femur. | More straight, with both ends less twisted, both ends less expanded. Condyles well ossified. | Massive, condyle less ossified. | Same | — |
| 32. Tibia | Proximal end more narrow, shorter than the femur. | ? Same | Same, only slightly shorter than the femur. | — |
| 33. Fibula. | Slender, more straight. | ? | ?Same. | — |
| 34. Calcaneum | Plate shaped | The same | ? | ? |

process of the premaxilla. In Huene's reconstruction the first preorbital opening is apparently too small and looks unnatural. Secondly, the well preserved skull roof described by Brink (1955, p. 146, fig. 2) gives further indication as if the two preorbitals are really present. According to the figure given by Brink, the anterior part of the nasal (the left side) a deep groove is formed between the anterior notch, very weakly marked, and a much stronger posterior one immediately before the constriction of the nasalia, very closely comparable with those of the Shansi species (cf. Figures 1,2,3,4 and 7). The anterior notch represents the upper posterior border of the nasal opening and the posterior notch the same of the first preorbital opening while the middle groove for the reception of the lower posterior process of the premaxilla. If this interpretation is correct, it remains hardly any doubt in assuming that there are two preorbital openings present in

*Erythrosuchus* too.

Less clear is the case of *Vjushkovia*. The posterior part of the left premaxilla (Huene, 1960, Tab. 11, Fig. 7) is broken, but the possibility of the presence of the lower posterior process is not entirely excluded. According to the figure by Orchev, only one rather small and pēculiarly shaped preorbital opening is present.

Keep the above points in mind we may go further in comparing these three genera more closely with our new form.

Compared with *Erythrosuchus* the following characters are found in *Shansisuchus shansisuchus* or nearly t' e same: (See above list) 1, 6, 9, 10, 12, 15, 16, 17, 18, 19, 20, 22, 23, 25, 26, 27, 29, 30, 32 and 34. This means that nearly two third of the characters are very close each other or quite the same. In addition the calcaneum of our form, although more thick and massive but is essentially comparable each other. It is thus quite obvious that *Erythrosuchus* must be the closest form so far known to *Shansisuchus shansisuchus*. On the other hand, the following characters of *Erythrosuchus* are quite different from those of the Chinese form: 2, 4, 5, 7, 8, 11, ?13, 28 and 29. The other features are more or less equivocal. Among the differences, the comparative narrowness of the skull, the peculiar shape of the supratempora opening, the absence of the parietal foramen, the shape and position of the frontal and the absence of the mandibular foramen are most striking.

Since the presence or the absence of an additional preorbital opening of *Erythrosuchus* can not be fully settled at now as noted above (although it is most probable) and in addition to the noted differences, we prefer to consider *Shansisuchus shansisuchus* as the representative of a new family the diagnosis of which is already given before. That the present family is widely different from Proterosuchidae is quite obvious. In the latter family the teeth are acrodont, the premaxilla bent downwards, the quadrate slants much backwards, the supratemporal opening directs more sidewards and first of all only one preorbital opening etc. Like the other two families the new family should be considered as a member under the super family pelycosimiodea of Huene or proterosuchia of Broom, and Proterosuchoidea of Camp.

As a result of the present study we can not agree with the current opinion that *Erythrosuchus* and consequently its related forms are a specialized end development. The quadrupedal way of posture itself is a primitive feature contrast to the mostly later two legged dinosaurs. The skull in general is not at all either specialized like that of Aëtosauridae (in the sense of Walker, 1961) or like that of other much smaller pseudosuchians with quite different arrangement of various openings. On the contrary, it seems very probably that the *Shansisuchus shansisuchus* represents nearly the ancestral stock, if not the direct one, of all the carnivorous saurischians with two preorbital openings or trace of them, commonly grouped either under Coelurosauria or Carnosauria. The upper Triassic *Teratosaurus* may be the direct survivor, as its skull is closely comparable with that of ours and the hand bones are very similar to that of ours too. The anterior limb is of course much reduced in the Upper Triassic form (See the ratios of *Teratosaurus minor*, Huene, 1932, p. 322) and the same of our form is much longer and truly quadrupedal. But the ratio of humcrus and radius and femur and tibia of *Shansisuchus shansisuchus* is already considerably shorter (79, table 10) and the time from the Upper part of Lower Triassic to the Upper Triassic would be sufficient for further reduction of the anterior limb. The skull of Jurassic and Cretaceous *coelurosaurus* and carnivorous dinosaurs such as *Compsognathus, Ceratosaurus, Megalosaurus, Antrodemus* up to *Velociraptor* and many others are more or less comparable with the skull structure of *Shansisuchus shansisuchus*. In all of the genera, the supra-temporal opening directs upwards, nasal opening terminal, small anterior preorbital opening and large posterior one, more or less vertically situated quadrate and large dental foramen present etc.

Current studies show that the order Saurischia comprises members of different origin. It seems more

and more clear that the origin of the carnivorous saurischians should be searched among the primitive thecodonts and our *Shansisuchus shansisuchus* is very likely one of the suitable candidate.

Compared with *Vjushkovia,* this genus shows a series of features found in *Shansisuchus* (5, ?7, 10, 11, 20, 24, 25, 27, 28, 33) but still more features are different from those of Chinese genus (1, 3, 6, 12, 13, 14, 18, 19, 22, 23, 26, 29, 30, 31). The other features are doubtful. The size of *Vjushkovia* is at least one half smaller than *Shansisuchus shansisuchus* and still more than *Erythrosuchus* and the geological age is much younger and I would think that it must represent a different genus.

Tatarinov considers this genus as a synonymy of *Erythrosuchus* but it is difficult to accept for the same reasons given above even it is less sure about the numbers of the preorbital opening. Of course *Vjushkovia* is a member of Proterosuchia and many features must be in common with its related forms.

In our collection we have also a much smaller species which will be described below.

Compared with Garjainia, only a few words to say about its relationship as already noted above. But according to the picture given by Orchev, the peculiar position of the sole preorbital opening, the rather downward bending of the premaxilla and the less vertical position of the quadrate and so on make very difficult to assume any close affinity with our species. Tatarenov considers this genus as also a synonymy of *Erythrosuchus* on the assumption that *Vjushkovia* itself is not valid because he compared much the features with the named genus. I can not agree with this conclusion both from the point of view of stratigraphy and anatomical features. The level of *Garjainia* according to the correlation of Efremov is lower part of Lower Triassic while *Vjushkovia* from lower part of Middle Triassic. As given above, *Garjainia* represents most probably a short headed Proterosuchidae and far apart from *Erythrosuchus.*

In conclusion, *Shansisuchus shansisuchus* represents a new family Shansisuchidae under the super-family proterosuchia. Its ancestral probability of the late carnivorous dinosaurs commonly known as Coelurosauria and Carnosauria is suggested.

### *Shansisuchus heiyuekouensis* sp. nov.

## I. GENERAL CONSIDERATIONS

In the course of the study of *Shansisuchus shansisuchus* at least three other *Pseudosuchians* are recognized in the locality 56173. Similar case occurred also in a few other localities. The one which seems to be very closely related to the preceding described form is treated here. This is dealt with a form smaller than and structurally quite different from *Shansisuchus shansisuchus.*

All the materials from 56173 and other localities are very fragmentary and their association is not clear so that we hesitate in establishing a new form for a while. This question is solved by the discovery of a nearly consecutive vertebra column, mostly presacral ones, associated with partially well preserved limbs of one individual from the locality 60116. This is used as the type and the others as referred specimens. Although it is conjectural in regarding the features observed from the referred specimens as really diagnostic for the present form, but it is most probably not far from the truth merely by way of elimination. The *Fenhosuchus* described below bears keeled vertebrae and larger in size with armored scutes and the other, *Wangisuchus tzeyii* is still smaller and equally armored. Both can not be mixed with the present form. Therefore we consider the characters of the referred specimens are fairly reliable.

## II. DESCRIPTION

**Type.** Seventeen nearly consecutive vertebrae with fragments of proximal and distal humerus, complete left femur, right femur lacking the proximal part and proximal parts of both tibiae, from 60116.

Cat. no. V.2513.

**Referred specimens.**

1. Hsishihwa, Lotzeyue, Wuhsiang (field number 56173). A left maxilla, two quadrates and some other fragments of the skull and lower jaw elements may doubtfully referred to this form (V.2514); 45 isolated vertebrae, 6 isolated sacral vertebrae; 2 left and three right scapolae and many fragments of the same; 1. left and five right coracoids; 2 left and 1 right nearly complete humeri and many proximal and distal end of the same 2 left and 5 right proximal ends and some; fragments of radius 1 nearly complete left ulna; 2 right ilia, and some fragments 1 left pubies, 1 left ischium; 1 distorted left femur and many incomplete fragments of the same. A few small calcaneums may be referred to here; 2 proximal ends of tibia. The above enumerated specimens indicates that there are about five or some more individuals from this locality.

2. Peipanching, Shihpi, Wuhsiang (5523). A few isolated vertebrae including sacral I, distal end of humerus, proximal and distal part of right femur and some fragmentary bones. V.2516.

3. Tanawa S. W. Tunghotsun (5526). A proximal part of right scapula. V.2498A.

4. Shihpienkou, Lotzeyue, Wuhsiang (5537). Framentary sacral rib, scapula, ?ulna belong possibly to this species. V.2517.

5. Hsiaotukou, S. of Ningchiao, Yueshe (5675). Distal end of a right femur. V.2518.

6. Longwokou, Lotzeyue, Wuhsiang (56156). Two distal parts of femura, proximal part of a tibia. V.2496.

7. Shihketung, Lotzeyue, Wuhsiang (56159). A few broken vertebrae coracoid and proximal and distal humerus. V.2494A.

8. Ehrlangshan, Wuhsiang (Exact locality unknown). An anterior caudal vertebra. V.2695.

9. Hutaikou, Tachang, Ningwu (NWC. E. D.). 6 sacral and caudal vertebrae, one sacral rib. V.2696.

**Horizon and locality.** Upper part of Lower Triassic. Heiyuekou, Shinghsien, N W Shansi (60116) and other localities given above.

**Diagnosis.** About one fourth to one half smaller than *Shansisuchus shansisuchus*. Neck vertebrae distinctly elongated, similar to that of *Chasmatosaurus*. Anterior dorsal vertebrae short elongating posteriorly. In few of them, traces of third articulation surface preserved. The lateral side of the anterior dorsal vertebrae excavated and the ventral side with a broad shallow groove and tend to decrease posteriorly. The ventral side of the posterior ones weakly ridged. Proximal end of the scapula subequal to or even less than the distal end. Humerus with the anterior proximal part spoon-shaped like that of *Haltico-saurus*. Pelvic girdle presumably similar to that of *Shansisuchus shansisuchus* but the pubes foramen is large and rather apart from the ischium margin. The ischium is short and stout although smaller. The femur is much more sigmoid and not so straight as that of *Shansisuchus shansisuchus* and other related forms.

## Description of the type specimens

**Vertebrae.** The preserved 17 vertebrae are given in Figure 38, A. arranged according to size and form which represents most probably the natural sequence. The numbers indicate the supposed position of the presacral, sacral and the caudal region. The numbers 19—20, 21—22 and 24—25 are still cemented by matrix. According to this arrangement the vertebrae 14—16 are missing. The first two, 9 and 10 represent the last two of the neck which are very similarly constructed as the following three anterior dorsal vertebrae. They are rather short and moderately constricted. The lateral side is distinctly excavated. In the ventral side it is marked by a shallow and flat groove. The parapophysis is lowly situated. Starting

from the seventeenth vertebra the centrum is elongated and the lateral depression becomes almost vanished. The ventral side is marked by a very weak ridge. The supposed two sacral vertebrae are damaged. Part of the root of the sacral rib is still attached to the vertebrae. The last two preserved vertebrae are considered to be the anterior caudal. The diapophysis is highly situated. The second one shows the facet for the chevron clearly. All the vertebrae are considerably smaller than the corresponding ones of the preceding described form, although they are certainly adult in age (Fig. 38, A, p. 47).

The two fragments of the ***humerus*** take the intermediate position of the larger adult and the younger ones of the referred specimens described below (Fig. 42, A, B). The proximal end belongs probably to the left side with only the part of posterior side near the condyle preserved (Fig. 42, A). The distal end is also a left one and fits in size with the above mentioned specimen and thus may belong to the same individual (Fig. 42, B). The ulna and radial condyles are well preserved. It narrows abruptly, especially the medial side, showing that the beam must be sharply constricted (Fig. 42, p. 52).

The complete left ***femur*** is similarly constructed as in the case of *Shansisuchus shansisuchus* but looking from the lateral the bone is distinctly more curved. The fourth trochanter is very faint. Both condyles are well developed. The right one duplicates essentially (Fig. 42, C—D, p. 52).

The ***Tibia*** is also rather curved as shown by the better preserved right side (Fig. 42, G—H).

Both the femur and the tibia are comparatively more slender.

## Description of the referred specimens

The following comments could be made on the referred specimens:

The left ***maxilla*** (V.2514A) illustrated in Figure 10, C (p. 13) is extremely small in size but fully in adult age and thus hard to be of *Shansisuchus shansisuchus*. It is also too small for being of *Fenhosuchus* described below. Its belonging to the present form is highly probable. In structure it is essentially the same as that of other maxillae of *Shansisuchus shansisuchus*. The upper process is situated rather backwards, its preserved teeth sockets are similarly formed. The inner side is also convex and outer side flat.

Two quadrates (V.2514B) also from 56173 are slenderly constructed and may belong to the present form too. There is no worth mentioning feature, however, at least in structure difference.

In other part of the skull and lower jaw of *Shansisuchus shansisuchus* described above hesitation may arise in attributing between the both forms such as the premaxilla figured in Figure 9, C, squamosal figured in Figure 14 A and so on (p. 13, 17).

It is therefore possible that they are belonging to the same species *Shansisuchus shansisuchus* and the difference in size indicates merely the variation of individuals or age. The other possibility is that the structure of the skull of the present form is essentially the same as that of the larger form, yet represents a separate species. In view of the difference in size and in structure of the vertebrae and limbs of the type is so distinct, we prefer to consider that the latter assumption is more probable.

There are two vertebrae shown in Figure 38, B and C (p. 47) require special consideration here. The elongated nature with deeply excavated posterior end (the anterior end is flat or only weakly excavated), lowly situated parapophysis facet (in the smaller one, it is rather faint but clearly present) and the distinct longitudinal median and lateral ridges at the anterior part and becoming fainter posteriorly indicate that they must belong to the neck vertebrae. However the upper part of the vertebrae is not satisfactorilly preserved. Their size fits with the present form and much too small for *Shansisuchus shansisuchus* and *Fenhosuchus* and too larger for *Wnagisuchus*. Unless there is an additional form represented by some vertebrae and pectoral girdle in the fauna besides the capitosaurids the belonging of the two neck vertebrae to the present new species is al-

most certain. If so, this makes one of the very characteristic features of this new species because of its long-stretched nature of the vertebrae. It is similar to that of *Chasmatosaurus* and later Upper Triassic saurischians.

The other vertebrae of 56173 are somewhat larger than the type. Its separation with the *Shansisuchus shansisuchus* is sometimes conjectural. But averagely it is clear that they are more probably closer to the small form. The two dorsal vertebrae from the locality 5523 (Fig. 38, D and E, p. 47) are somewhat larger than the corresponding vertebrae of the type. In both, the part above the centrum is preserved. The distal end of the spina dorsalis is narrow and long and almost no distal thickening. The diapophysis is short, one directing more upwards (belonging to the anterior part) and the other slightly downwards (belonging to the posterior part). Very interesting is the presence of a distinct thickening part below diapophysis along the lammella connecting the diapophysis and the centrum, indicating the development of the third articulation facet of the rib as in the case of *Vjushkovia* described by V. Huene. In none of the rich collection of the vertebrae of *Shansisuchus shansisuchus* and other forms in my disposal such feature is observed. It is therefore very probable that these two vertebrae and other remains of this locality (small vertebra and limb-bones) belong to this species.

The scapulae (Fig. 39, A, B) referred here are in general smaller than those of *Shansisuchus shansisuchus*. In addition the distal end is decidedly narrower or at least subequal with the proximal end. In coracoid (Fig. 39, C, D) the difference is not so clear besides its smallness. As in the case of *Shansisuchus shansi*-suchus the glenoid surface is sometimes very thick. The coracoid foramen is submarginal (p. 48).

The better preserved **humeri** (Fig. 40, A—D) referred to this form seem to be distinguished by the following features: Size smaller, the proximal part and the lower part are more twisted, the deltoid crest tends less downwards. (the specimen shown in Fig. 40, A is an exceptional one in which the deltoid crest extends considerably downwards. This part looks much depressed and thus distorted). The anterior proximal part of the bone is characteristically spoon-like depressed. The proximal end is neither truncated as in the case of *Shansisuchus shansisuchus* nor abruptly bent as in the case of *Fenhosuchus*. The shaft is comparatively short. The distal end is less expanded with the radius and ulna condyle only weakly separated. On the whole the humerus is more close in similarity to *Halticosaurus* rather than to *Erythrosuchus* according to the illustration of Gregory (1951, vol. II, pl. 525, 530). In general shape it is more closely *comparable* with that of Stagonosuchus than with that of *Vjushkovia* (p. 49).

Of the lower arm a complete right **ulna** from 56173 and 5537 are intact (Fig. 40, E). It is decidedly shorter than the humerus and looks rather slender. The shape is essentially the same as that of *Shansisuchus shansisuchus* but smaller. Many fragments of ulnae and *radius* may be attributed to this form but no special features can be detected.

It is difficult to distinguish the **ilium** from that of the above described form (Fig. 41, A—B). Besides the somewhat smallness the pubic and the ischian border seem to form a more distinct obtuse angle and the anterior process is a little developed. On the whole it is very similar to that of *Shansisuchus shansisuchus* (p. 51).

The general shape of the **pubes** (Fig. 41, C) is almost the same as that of *Shansisuchus shansisuchus* but the well rounded pubic foramen is large, oval and far apart from the ischian border. As the pubes of *Fenhosuchus* is quite differently constructed with long shaft, this can only be possible to belong to this form.

The ischium referred here is also very characteristic (Fig. 41, D). In general shape it is closely comparable with that of *Shansisuchus shansisuchus* but more short and thick, and the contact surface of the ilium

border and the part of the acetabulum are not well separated.

Two other specimens may be briefly noted here. One is the left ilium. Its lower part is damaged (Fig. 41, E). The extraordinary thickening at the anterior lateral part must be interpreted as pachyosteological. This view may be supported by the fact that at the inner side there is no trace of the impression of the sacral ribs and the whole area is weakly concave. The other specimen is the right pubes (Fig. 41, F). Although small, its general shape is the same as the above described one but the trace of the pubic foramen is only faintly marked by a groove at the ventral side and wholy disappeared at the visceral side. The anterior medial margin is much simplified, so that it forms only a blunt pointed distal end instead of a real border (p. 51).

The belonging of these two specimens is rather doubtful. The peculiarities of the pubes may indicate the presence of another form of thecodonts in the fauna. I shall come back in dscusion of them in other occasion below.

The ***femur*** given in Figure 42, E from 56173 is a pachyosteological specimen. It is the left side with both ends much deformed. The rugged part near the proximal end is entirely in confusion or coosified with the shaft indicating that animal was injured during life and the distal end showing similar appearance without a clear separation of the condyles. In lateral view the bone is characteristically S-shaped in curvature same as the intact specimen of the type (p. 52).

The upper and lower parts of the right femur presumably belong to the same individual from 5523 (V2516) shows also injury and subsequent recovery of the bone. The broken part of the upper one is distinctly thickened, the broken surface smooth and the bony cavity is entirely closed. In the broken part of the distal part it is damaged and not so clear. The anatomical structure is the same as that of the type. It is a little larger in size.

A few ***calcaneums,*** smaller in size, may belong to this species. The general structure is essentially the same and need not be repeated here.

**Table 12. Important measurements of *Shansisuchas heiyuekouensis* sp. nov. (in millimeters)[1]**

| | |
|---|---|
| **Maxillary.** | |
| Preserved length | 118 |
| Height before the upper process | 44 |
| Height behind the upper process | 41 |
| **Quadrate.** | |
| Estimated height | 168 |
| Width of the lower condyle | 37 |
| **Vertebrae.** | |
| Ventral length and posterior breadth of the type ······ 31 and 41 (38, A, 9); 36 and 39; (38, A, 10); 32 and 37 (38, A, 11); 32 and 41 (38, A, 12); 34 and 42 (38, A, 13); 34 and 34 (38, A, 17); 37 and 35 (38, A, 18); 41 and 35 (38, A, 19); 39 and 36 (38, A, 20); 41 and 38 (38, A, 21); 37 and 37 (38, A, 22); 42 and 39 (38, A, 23); 41 and 38 (38, A, 24); 39 and 35 (38, Sc, I); 29 and 32 (38, Sc, П); 32 and 31 (38, C, I); 27 and 29 (38, C, 2). | |
| Ventral length of the referred neck vertebrae 42 (38, B); 58 (38, B). | |
| Ventral length of the referred dorsal vertebra 38, C | 38 |
| Total height of the same | 115 |
| Ventral length of the dorsal vertebra 38, D | 43 |
| Length from prezygapophysis to postzygapophysis of the right side of the same | 58 |
| **Scapula.** | |
| Length of 39, A | 202 |
| Proximal breadth (39, A) | 89 |
| Distal breadth (39, A) | 86 |

1) The reader is kindly requested to refer to the corresponding measurements of *Shansisuchus shansisuchus* given in above tables for comparison. Table 4, p. 124; Table 6, p, 135 and Table 7, p. 137.

Length of 39, B ··· 197
Proximal breadth (39, B) ···87
Distal breadth (39, B) ···66

**Coracoid.**

Maximum length of 39, C ··· 105
Length of the scapula border 39, C···71
Maximum length of 39, D ···86
Length of the scapula border 39, D ···60

**Humerus.**

Total length of 40, A ··· 191
Proximal breadth 40, A ··· 120
Distal breadth 40, A···81
Total length of 40,B··· 210
Proximal breadth 40, B ··· ?90
Distal breadth 40, B ···83
Proximal breadth of 40, C ···97
Proximal breadth of 40, D ··· 112
Distal breadth of the type( 42, B) ···61

**Ulna.**

Length (40, E) ··· 159
Proximal breadth of the same···43
Distal breadth of the same ···33

**Ilium.**

Minimum breadth above the acetabulum of 41, A ···42
Breadth of the acetabulum of the same ···86
Anterior posterior length of 41, B··· 165
Minimum breadth above the acetabulum···51
Breadth of the acetabulum ···68

**Ischium.**

Length of 41, D··· 107
Breadth of the same ···88

**Pubis.**

Length of 41, C··· 146
Breadth of the same ··· 122

**Femur.**

Length of the type 42, C··· 260
Proximal breadth of the same ···66
Distal breadth of the same ···62
Distal breadth of the type 42, D ···62
Length of 42, E··· 210
Proximal breadth of 42, F ···69
Distal breadth of 42, F···65

**Tibia.**

Proximal transversal and sagital breadth of the type 42, G ···58×41
Proximal transversal and sagital breadth of the type 42, H ···59×48

## III. DETERMINATION AND DISCUSSIONS

Unfortunately the type specimen is not sufficiently well preserved, especially the skull part, the pectoral and pelvic gildle are totally missing. The well preserved part shows that the skeleton must be embedded in matrix completely. Nevertheless, the vertebrae and limb bones so far known are sufficiently clear that we have to deal with a new form. The size of the vertebrae of the type is no less than one half smaller than that the corresponding ones of *Shansisuchus shansisuchus* and the size of the femur and the tibia are at least one fourth smaller than those of the same species. Yet it is certainly fully adult in age as shown

by the nature of the vertebrae and the well formed condyle of the femur. The coossification of the sacral vertebra and the sacral rib may support this view. Although the general structure of the vertebrae is very similar to the above described form but the centrums of the present species are clearly comparatively longer and the femur is much bent in a S-shaped way. It is, therefore, obvious that the skeleton of Heiyuekou represents a form different from the much larger *Shansisuchus shansisuchus.*

Whether the present form should be considered as the representative of a new genus or as only as a member of the genus *Shansisuchus* is a question to decide with much hesitation.

Facts in favour of referring the new species under the genus *Shansisuchus* are; First, the vertebrae and the limb bones of Heiyuekou are essentially comparable with the form described above; Second, in the referred specimens listed above there are a series of features similar to those of *Shansisuchus shansisuchus,* such as the general shape of the scapula, coracoid, ilium, and the calcaneum. And the third, In some cases the distinction in size is not quite clear such as the larger vertebrae the rather large humerus, and the pelvic bones. Considering all these points it seems not necessary erect a new genus and to put this form as a member under the genus *Shansisuchus.*

Facts in favour of making a new genus are: First, the elongated nature of the neck vertebrae and dorsal vertebrae. Second, the humerus is quite different from that of the named form. Third, the strong bending of the femur. The latter two features mean a more active life of the animal and it is highly probable that our form seems much slender in structure and at least not so plump as that of the gigantic *Shansisuchus shansisuchus.* Fourth, the presence of a large submarginal pubic foramen and the structure of the ischium is short and thick. To the writer he is rather convinced in attributing all the above named bones to the present species, although some of the specimens are rather large in size. They are quite different in structure as compared with those of the other forms of the fauna. In doing so, those characters must be considered as equally diagnostic for the present species.

Taking all those in account, I considered for present the above listed remains as a new species under the genus *Shansisuchus,* the diagnosis of which has been given before.

Although the distribution of *S. Heiyuekouensis* is not so wide as that of *S. Shansisuchus* it covers roughly the same area from S W to N W Shansi. It is not recorded in the Ningwu basin and also missing in Chinglo region. Although it is not so abundant as in the case of *Shansisuchus shansisuchus,* but by no means rare in occurrence. In most cases they were found together, so that we believe that they are of the same stratigraphical horizon.

The material at disposal is not sufficient to make a reliable reconstruction. If the maxilla mentioned above is correctly referred, the shape of the skull must be rather the same as that of *Shansisuchus shansisuchus* with two preorbital openings. Even the pelvic girdle differs not so much from the named form, if one takes not too seriously, the consideration of the features of the pubes and the ischium as described above. On the whole, the both bones are rather short and plate-shaped and thus comparable with those of *Shansisuchus shansisuchus.* In detail our form differs from the pelvic girdle of both genera *Erythrosuchus* and *Vjushkovia,* especially in the shape of the pubes. This bone of *Erythrosuchus* is less twisted and of *Vjushkovia* with a distinct shoulder at the lateral proximal part. The vertebrae and the limb-bones of the new form are even sufficiently characteristic even generically. It seems that the limb-bones are comparatively more advanced than that of *Shansisuchus shansisuchus,* although there is no stratigraphical distinction.

In South Africa there is so far no smaller form of Erythrosuchids reported. The skull roof recently described by Brink (Brink, 1955) is 756 mm long and about the same size of the specimens described by

v. Huene. It is very unlikely to assume that our form may be related to proterosuchids with the downwards bending of the muzzle, although the skull remains are poorly known. In all of them there is a single preorbital opening.

In Russia the so far known pseudosuchians are all different from the present form. The much older *Archosaurus rossicus* and the acrodont *Chasmatosuchus* need not be considered here. All the other forms show no positive proof of the presence of two preorbital openings, certainly one only in *Garjainia prima* according to the picture given by the author, most probably also only one in *Vjushkovia triplicostata* (although the broken part of the premaxilla is somewhat debatable) and the form *Dongusia colorata* is only represented by a single vertebra. According to Tatarinov, all the three forms are placed in the family *Erythrosuchidae* and belong to the same genus *Erythrosuchus.* As I have stated above there is a possibility that the large form *Erythrosuchus africarus* including the neo-type of Brink may possess two preorbital openings as in the case of our form and at least in *Garjainia* a single preorbital opening is sure, so that it is quite doubtful in believing that they belong to this genus. On the other hand, in size all the three Russian forms are much smaller than the forms of South Africa and more or less the same dimension with our present new species. I would rather think that to combine all the Russian forms in one genus is highly improbable from the points of view like the smaller size, different structures in the skull and wide geographical separation.

It is, on the other hand, very probable that the Chinese form may bear some close relationship with the one or the other of the Russian genera. Based on the reasons given above the genus *Garjainia* should be first discarded by its shape of the skull. The suggestive link of a closer relationship with *Vjushkovia* may be indicated by the presence of the third articulation surface of the dorsal rib but the stratigraphical position of this form is much higher and need not be considered seriously. The level of *Dongusia* is lower and in addition its material is too poor for further speculation. In conclusion it is hard to assume any sure identification between all these forms, both generically and specifically.

## SUPER-FAMILY CHIROTHERIOIDEA v. HUENE 1956
## (STAGONOLEPOIDEA v. HUENE 1942)
### ?Family Rauisuchidae v. Huene 1956
### Genus *Fenhosuchus* gen. nov.

With the diagnosis of the type species *Fenhosuchus cristarus.*

#### *Fenhosuchus cristatus* sp. nov.

**Material.** Most of the remains were found from the locality 56173 and fragmentary. Since the part of the skull and other parts of the skeleton are less well preserved we prefer to choose the vertebrae shown in Figure 44, namely, 44, A; 44A′; 44, E; 44, F; 44, G; 44, J and 44, M, as the type, because parts of them are in consecutive series and judged by the greyish color of the bone and the matrix they are probably belonging to the same individual. The other various parts of the vertebrae shown in the same figure were selected from eighty two vertebrae for giving better understanding of the entire vertebral column. The other remains referred to this species are: 2 premaxillae, 5 quadratum, 5 lower jaw fragments, and dermal, and many post cranial bones. Cat. number of the type specimens V.2697. It is no less than five individuals represented in this locality.

**Referred specimens from other localities.** It is rather poorly represented in other localities and enumerated as follows:

1. Chungchuekou N. Changtsunkou Wuhsiang. A broken neck vertebra (5534m). V.2499A.
2. Hsiatukou, Ningchiao, Yueshe. A left pubis and dermal scutes (5674). V.2493A.
3. Shihketung, Lotzeyue, Wuhsiang (56159). Four vertebrae, tibia astralus and probably dermal bones. V.2494B.
4. Yangchuanpu (exact locality unknown but certainly from Wuhsiang). A proximal end of tibia V.2698.
5. (8) (exact locality unknown certainly from Wuhsiang). An anterior neck vertebra. V.2699.

**Diagnosis.** A large pseudosuchian about the size of *Shansisuchus shansisuchus*. The referred premaxillae indicate a single preorbital opening. Quadrate robust with the lower end rather convex and the anterior concave side more shallow and flat. Lower jaw comparatively low and bent laterally at posterior part. Neck vertebrae relatively long, being subequal in length with the dorsal vertebrae. They are more or less sharply laterally compressed with ventral crest distinctly developed. Anterior dorsal vertebrae with a lateral crest starting behind the parapophysis running posteriorly and vanishing near the posterior margin of the centrum. There is no such crest in the posterior dorsal vertebrae. All the neck and the dorsal vertebrae are platycoelous or weakly amphycoelous. Scapula is similar to *Shansisuchus shansisuchus*. Coracoid with large coracoid foramen, or may appear as two adjacent ones. Humerus with the deltoid crest sharply bent with the proximal end. Ulna bears very heavy proximal end. Radius broad. Pubes with large pubic foramen and massive distal end. Ischium also elongated. Femur slender and S-shaped bent, the proximal and distal planes are twisted nearly in right angle. Tibia with the proximal end massive and there is a distinct ridge developed at the lateral side. Fibula rather broad. Astragalus prosauropod-like. Calcaneum not plate-shaped. Metatarsus short and robust. Dermal scutes developed as in Rauisuchidae.

**Horizon and locality.** Localities as noted above. Upper part of Lower Triassic or Lower part of Middle Triassic.

## I. DESCRIPTION

Since the remains of this form are poorly known from the localities other than 56173, our observation is practically based upon the material of the later locality. As noted above the vertebrae are very characteristic and be easily distinguished from those of *Shansisuchus shansisuchus*, although the both forms are close in size. Since the poorly represented cranial elements and the post cranial bones are found isolatedly and almost no connection data with the vertebrae, it is possible that their belonging may be of conjectural nature, or even in error. But it must be added that most of the identifications are reliable because most of the features of different bones can be easily distinguished from corresponding parts of either *Shansisuchus shansisuchus* about the same size or the smaller species of the same genus or still much smaller and equally characteristic *Wangisuchus* to be described below.

As shown below the size of the different parts of the bones varies considerably and also differ in details concerning their structure. It is possible that we may deal with two species. It is however, more likely it is only a matter of variation or difference in sex, so that we consider all the remains listed above as belonging to a single species.

### Skull remains and lower jaws

The two *premaxillaries,* one smaller belonging apparently to a younger individual and the other much larger in adult age, are certainly excluded from *Shansisuchus* and to be considered here. The smaller right one is more convincing. There is no trace of the middle posterior process separating the nasal opening and the first preorbital opening. The upper border is rather convex instead of more straight or even concave

as in the case of *Shansisuchus shansisuchus*. The lower posterior process is more broad. We thus conclude that the posterior concave opening should be interpreted as the anterior part of the nasal opening and not as the first preorbital one. At the upper anterior part there is no trace of the root of the upper process as in the case of *Shansisuchus shansisuchus*. Unfortunately the border of the nasal opening is damaged but the lower posterior part is well preserved. The lateral side of the lower posterior process is smooth and marked with a faint groove evidently in connection with the anterior end of the maxilla. On the inner side, there are about six alveoles separated by the zigzagged triangular bony plates as in the case of *Shansisuchus shansisuchus* described above. At the first alveole there is a broken fresh unfunctional tooth showing traces of the presence of serratation both at the anterior and posterior borders. It is clear that the dentition of our form is sub-thecodont and similar to that of *Shansisuchus shansisuchus*. Length from the anterior lower border to the posterior end of the lower process, 118 mm. Length from the anterior border to the anterior border of the nasal opening, 95 mm. (Fig. 43, A). The larger specimen, also a right, shows mostly the same features as the above described one. The external side is more convex and the posterior part is damaged and the alveoli are not so well preserved. But the convexity of the upper border and traceless of the upper process at the anterior upper part indicate that it is highly probably that it belongs to here described form (p. 55).

A right **lacrymal** may be referred here as it is differently constructed as compared with that of *S. Shansisuchus* (Fig. 43, C). The downward extension in connection with the jugal is well preserved. It belongs to a large beast.

Although there are five **quadrates** preserved, only one is better preserved (fig. 43, D) and the an other nearly complete one showing the anterior side still embedded in matrix, the others merely represented by the distal ends. In this better preserved specimens it is characterized by the following features: The two wings form not a right angle as in the case of *Shansisuchus shansisuchus*, but a much obtuse angle. The distal end is not weakly concave but more convex or rounded. The posterior side above the distal end is not flat but weakly depressed while the other side is rather flat. The large specimen shown in Figure 43, D fits in size with the large premaxillary described above and the large vertebrae and limb-bones but not with the median sized vertebrae and smaller limb-bones. Total length of the figured specimen, 219 mm. Breadth of the distal condyle, 72 mm (p. 55).

The best preserved dentary is the right one shown in Figure 43, E. Both ends are missing. Judged by the expanded portion the lost part may not be too much. The total preserved length 265 mm; height at the anterior broken end 54 mm, and that near the posterior end 42; minimum height 34 mm. In the upper view the dentary shows eight loosely spaced alveoli which are more or less antero-posteriorly elongated. On the external side there is a slightly oblique groove below the upper border. On the posterior part of the inner side the deep trough for reception of the speniale is especially prominent. Anteriorly the Meckelian groove extends far forwards much like that of *Hesperosuchus* (Colbert, 1952). The posterior portion of the bone bends distinctly laterally so that the whole bone looks much more curved than that of *Shansisuchus shansisuchus*. On the whole, the present dentary differs from that of the *Shansisuchus shansisuchus* by the less height, the peculiar curvature and the well developed Meckelian groove. It is too large for both *Shansisuchus heiyuekouensis* and *Wangisuchus*. Its attribution to the present form seems very probable. The same holds true for the cranial elements described above.

## Vertebrae

All the characteristic vertebrae of this form are illustrated in Figure 44. With the exception of a

few points all the features of the non-figured specimens can be observed here. They are briefly described as follows (p. 57):

**Neck vertebrae.** There are about 14 neck vertebrae of which seven are illustrated in Figure 44 A, A′, B, and C. A. and A′ are considered as part of the type and may belong to the same individual. In A two vertebrae are still in natural connection and represents probably fourth to fifth vertebrae. The proximal portion of the neck rib is still in natural position attached to the parapophysis and diapophysis facet of the anterior vertebra. In A′, three vertebrae are in consecutive series with most of the parapophysis and diapophysis facets in good condition. They represent posterior part of the neck, probably 7—9th.

In all the five vertebrae the centrums are sharply compressed and weakly amphycoelous, the posterior end being more excavated. The ventral side is marked by a prominent longitudinal keel. Behind the parapophysis which lies rather high above the anterior lower end, there is a swollen part separating the depression above the ventral keel and the fossa a distance below the diapophysis. It develops never as a real keel or ridge as the anterior and middle dorsal vertebrae. The diapophysis is extremely short and directs strongly downwards. The pre- and postzygapophysis are robust. The specimen figured in Fig. 44, B is a extremely abnormal vertebra belonging probably to the posterior part of the neck. Its ventral keel is not so sharp as the posterior two of 44, A′. The parapophysis at the left side is strongly developed while that of the right side is almost absent as indicated by the damaged surface. The centrum of the right side lateral to the neural canal is very much reduced. Such abnormality of development is also observable in the preceding described specimens. In Fig. 44, A the diapophysis seems missing or poorly developed in the right side while that of the left side is normally developed. The parapophysis of the left side is decidedly stronger than the other side. The same is for the specimen 44, A′. The specimen 44, C belongs to the middle part of the neck probably the fifth or sixth one. The position of the parapophysis lies rather low, the diapophysis directs more downwards. The ventral keel is prominent, the other referred neck vertebrae denote essentially the same features. A few vertebrae with the anterior ends somewhat convex or even both ends convex are also tentatively referred here, since the other features fit exactly.

In all the neck vertebrae described here are averagely somewhat longer or at least subequal in length as compared with the dorsal vertebrae in contrast with the condition of *Shansisuchus shansisuchus*. Together with the other characters described above it can not be mixed with the named form, although the size of them is close each other.

**Dorsal vertebrae.** There are about 35 vertebrae certainly belong to the anterior dorsals. The specimens 44, E; 44, F; 44, G; 44, J are probably belonging to the same individual as A and A′ as judged by the matrix and color of the bone. The others (44, D; 44, G′; 44, I; 44, K and 44, L) are the better preserved anterior dorsal vertebrae. Since most of the unfigured specimens show more or less the same features, so that our observations are restricted chiefly to the illustrated specimens.

The most anterior dorsal vertebrae are easily distinguishable from the neck ones by the generally well defined triangular parapophysis, by the sharply developed ventral keel and non-sharply compressed centrun. The lateral keel is not so prominent in those next to the neck and may be sometimes difficult to distinguish from the posterior neck vertebrae. Actually some of them may represent the most posterior part of the neck. The lateral ridge becomes more distinct in the middle dorsal vertebrae as the parapophysis shifts upwards and vanishes from the centrum. The parapophysis is located rather low. The diapophysis, when preserved, is still shorter then that of the neck vertebrae. A few vertebrae have no trace of the parapophysis belonging certainly to the posterior part of the anterior dorsal column, but the lateral keel is still well developed. The pre- and postzygapophysis are only preserved in a few ones which are nothing special.

The spina dorsalis is mostly missing but looks poorly developed as judged by the part of the breakage of its root.

Like the neck vertebrae, many of the dorsal vertebrae are also abnormally developed. It is clearly shown in Figs. 44, E and 44, K in which the both sides are clearly not symmetrical. In some of the others the parapophysis and the lateral crest are well and normally developed in one side, while in the other side they are either smaller or reduced.

According to the size, the anterior dorsal vertebrae may be grouped in three types. Most of them are adult only a few are apparently young individually, and some are extremely larger ones (44, K and 44, L).

**Posterior dorsal or lumbar vertebrae.** They are comparatively poorly represented. In about 20 lumbar vertebrae 44, M and 44, N are illustrated. The first named one may belong to the same individual as the other types while 44, N belongs apparently to a young one and distorted. The important features of the lumbar vertebrae are the markedly compression with a more or less well developed ventral keel of the centrum. The lateral keel so well developed in the anterior dorsal vertebrae becomes traceless. The parapophysis shifts upwards above the centrum and is reduced connecting the diapophysis by a lamella. The latter directs more sidewards and almost horizontal. It is of course small. It is difficult to determine their exact position in the vertebrae column, but the rather shorter ones are apparently before those distinctly elongated ones. A specimen with the parapophysis and the diapophysis almost confused and forming a crescent contact surface may belong to the one immediately before the sacrum. It is a rather young individual.

**Sacral vertebrae.** There are three first sacral and probably one second sacral vertebra referable to this species and they are figured in Fig. 44, Q and 44, R respectively. In size both the vertebrae are very close to the smaller specimens of the *Shansisuchus* but differ from them by the sharply compressed centrum with distinct ventral keel. In fact it is the only sacral that is keeled and differs easily from all the other three pseudosuchians in our collection. In addition the anterior end is only slightly larger than the posterior one. Both ends are transversally narrowed instead of expanded ones in other forms. All sacral vertebrae are somewhat smaller for the adult neck and dorsal vertebrae described above and may belong to rather young individuals.

**Caudal vertebrae.** Only eight caudal vertebrae are referred to this species (Fig. 44, O and 44, P). Their exact position is difficult to determine. The relatively short one may belong to the anterior part of the tail and those elongated ones to the middle part. No one with the neural arch preserved. The ventral side is sometimes keeled and sometimes distinctly marked by a broad furrow bordered by ridge at each side depending probably on the relation position of the vertebrae. It is not so remarkably constricted as in the case of *Shansi. shansisuchus*. The facet for the attachment of the chevron bone is recognizable in some of the vertebrae.

**Ribs.** There is no sure presence of neck and dorsal ribs in the collection except the proximal part of the neck rib mentioned above of which the tuberculum and the capiculum are widely separated. The sacral rib is probably represented by two left and one right illustrated in Figure 45, A—C. They are all second sacral ribs varied considerable in thickness but their general shape and structure are essentially the same. The contact surface of the vertebral side is thick and the side in connection with the ilium is much expanded as compared with that of the same bone referred to *Shansisuchus shansisuchus*. The distal side of the right one is very thin due probably to juvenile stage of the bone, although its size is about the same as the others. The shape of the bone, rather difficult to describe is easily seen in the given Figure (p. 59).

## Pectoral girdle and fore limbs

It is difficult to separate the ***scapula*** which is certainly belonging to this species from that of the large species *Shansisuchus shansisuchus.* The here referred few specimens are distinguishing from those of the latter form by its less massiveness, more constricted middle shalf and less truncated disted end. The nearly complete specimen of the left scapula shows that the distal end is considerably narrow than the proximal end and may be a character differing from the large species of *Shansisuchus.* Its size takes approximately the intermediate position between the two forms of the named genus.

A right ***coracoid*** from 56173 sticking still to an anterior dorsal vertebra of *Fenhosuchus*-type belongs most probably to this genus. It differs from the coracoid of *Shansisuchus shansisuchus* by the large perforated coracoid foramen. It is sub-rectangular in outline istead of rather triangular of the named genus. Length and height 111 and 91 mm. respectively. A right coracoid from 56159, ventral border broken, shows the same large coracoid foramen also found in association with a number of vertebrae of *Fenhosuchus,* and belongs probably to this species also. A third coracoid from 56173 with a deep oval fossa at the position of the coracoid foramen but not perforated. In this specimen two additional depressions are found, one at the medial side near the scapula border and another one at the lateral side, as the extension of the larger one of the medial side behind the non-perforated coracoid foramen. Trace of such depression at the medial side is clearly shown in the specimen of 56159. Such structure is never found in *Shansisuchus shansisuchus* and can only be referred to this genus, either as an abnormally development or as the indication of the presence of a second species of the same genus as also indicated by the vertebrae. We consider the former case is more preferable (Fig. 45, D—G, p. 59).

**Humerus.** Five more or less complete humeri and a number of proximal and distal ends of the same are referred to this form of which three are figured in Fig. 45 H—J. They are varying considerably in size due apparently to the difference of age. Comparing the humerus with that of *Shansisuchus shansisuchus* it is characterized by the sharp bending, less than 90 degrees, of the proximal end and the deltoid crest. The latter stops high above the middle point of the shaft. The most extreme case is the right one (45, I) of which the proximal end forms a very acute angle with the deltoid crest that is thickening at the distal part. There is no sign of deformation but it is probably somewhat abnormally developed. In the other two humeri the high position of the deltoid crest is well shown and the sharp bending of the proximal portion is also clearly indicated. The proximal part of 45, H is broken medially. This specimen is especially large in dimension and the deltoid crest rather low and may belong to either a adult individual or indication of a second species (p. 59).

**Ulna** Fig. 46, B represents the left ulna most probably belonging to this species. The both ends of it are damaged. It looks more stout and straight than that of *Shansisuchus shansisuchus.* Its shaft is comparatively thick (Fig. 46, p. 60).

A much larger and rather peculiarly constructed right ulna showing in Figure 46, C belongs probably also to this species. The proximal end thickens strongly and then narrows suddenly distally. The anterior and lateral depressions below the proximal end are deeply excavated. The shaft is curving strongly. The bone becomes slender distally until the distal end which is a little thickened. This part of the bone is partly damaged, but the expansion is clearly recognizable. Another distal end referring to the same species shows that the distal end is strongly convex. The structure of these two specimens differs considerably from the left one described above, but it is still very probably that they belong to the same form since one of them is probably abnormally developed. It is however also possible that it belongs to another species of the same

genus. At least three proximal ends of ulna of this type but smaller may be referred to this form.

**Radius.** Only one left radius is (46, A) referred to this species. It differs from that of *Shansisuchus shansisuchus* by the more expanded proximal and distal ends and consequently more stout in appearance.

## Pelvic girdle and posterior limbs

The pelvic girdle is very poorly represented (p. 60).

There is no sure specimen which can be referred as the *ilium* of this form. The peculiar left ilium given in Figure 46, D is an extremely abnormally developed specimen. It is associated with the distal part of a right quadrate of the type described for this form and may suggest a closer relationship of both. The pubic and ischium border is relatively differentiated but forms still an obtuse angle as that of *Shansisuchus shansisuchus.* (In other two unfigured specimens referred to this form, it is still better separated.) Very Peculiar are the anterior and posterior ends. The anterior one is incomplete in the marginal part but there is a special process developed at the inner side where the impression of the first sacral rib should lie. The posterior border is peculiarly thickened with also a medial projecting part. There is also no clear trace of the impression of the second sacral rib. The upper border of the ilium is damaged but it is clearly separated from posterior end. The entire bone shows no distortion and such strange shape of the bone must be considered as original structure. I should like consider it as an abnormal development of no taxonomic value. Since the ilium blade is not preserved and acetabulum part is on the whole so similarly built in all the pseudosuchians, it is obvious that the present specimens are not sufficient for a precise determination.

Although the ***pubes*** (Fig. 46, E—F) are also poorly represented, but the two figured specimens indicate that it is quite differently constructed as compared with that of *Shansisuchus shansisuchus* and is very characteristic. One is the proximal part of a left one (Fig. 46, E) from Hsiaotukou, Ningchiao, Yueshe (5674, V. 2493A) with a very large pubic foramen. The contact with the ilium is narrow and well separated from the part of the acetabulum surface which is partly broken. The contact surface of the ischium is intact and shows that the pubic foramen is very marginally situated and even partly cut by the named surface. The bone is broken distally but it is must be rather long before reaching the distal end.. The single pubic foramen indicated that the pubes is closely comparable with that of *Stagonosuchus nyassicus* Huene (1938). The other specimen from 56173 represents the distal part of the right pubes. The lateral thick side is weakly curved. The posterior-anterior thin blade is partly damaged but clearly recognizable. The distal end is thick and rectangular in outline. The two specimens make clear that the pubes of this form is of elongated type. Three distal ends, somewhat smaller, may be refer to the pubes of younger individual.

The ***ischium*** is also poorly represented, all proximal and distal ends are of fragmentary nature (Including one from 56160), V. 2700 and a pair of distal ends from Hutaikou, Tachang, Ningwu (Nwc. E. D. V. 2502A). Both the proximal and the distal ends show that they are of elongated type and quite different from that of *Shansisuchus shansisuchus*. None of the proximal end is complete but the expanded nature is clearly seen and very similar to the ischium referred to *Wangisuchus* described below. The distal ends are represented by four specimens, some with the ends rather thickened and their belonging to this form are doubtful. The best specimens for the ischium are the two still in natural position which is shown in Figure 46, G. In this pair of ischium the preserved part narrows only moderately from the distal end upwards. The end is crescent and both are closely in connection. The side marked by sharp oblique ridge is probably the anterior inferior side. Length of the distal end, 42 mm and breadth of both, 36 mm. They are much larger than ischium of *Wangisuchus*. Its belonging to the present species is highly probable.

On the whole the pelvic girdle of the present species is poorly known. Its referring to this form is

not at all sure. But since some features especially those of the pubes and ischium are so characteristic that their belonging to this form is very probable. Their size is comparable with those of the large species of *Shansisuchus shansisuchus* but the shape is quite different. Unless there is another form besides the here described species of the fauna their belonging to *Fenhosuchus* seems apparent.

The ***femur*** is represented by one left and three right complete ones and a number of proximal and distal ends. It is differed from that of *Shansisuchus shansisuchus* by the distinct twisting of the both ends. The plane of the proximal end is nearly 90 degrees to the distal expansion. With the exception of the left one which is more S-shaped curved in lateral view the bone is rather straight. The outline of the proximal and the distal ends are rather variable. The forth trochanter is relatively weakly developed. In the left one (47, A) and the smaller right one (47, C) the middle part of the shaft is distinctly laterally compressed while the larger right one (47, B) is less so. In some of the isolated proximal and distal ends they are rather thickened. Their belonging to the present species is doubtful. The possibility of the presence of more than one species is very likely (p. 62).

The ***tibia*** is represented by two left proximal ends, a complete right one, a right proximal end and a number of poorly preserved both ends. The complete right one is decidedly smaller than the others but still larger than that of *Shansisuchus heiyuekouensis*. The lateral upper side is much depressed or damaged, the distal end is also damaged. It is rather straight bone with the proximal end rather oblique and the sagital and transversal breadth subequal. The other three figured specimens are more robust and may belong to larger or mature individuals. The outline of the proximal ends varies considerably but more or less laterally compressed. They are all larger than the tibia of *Shansisuchus shansisuchus*. Nevertheless our specimens look much slender than most of the tibia of stagonolepids. So far, as the poorly preserved tibia of *Stagonosuchus nyassicus* (Huene, 1938) is concerning this very bone of both is closely comparable, especially that of the complete right one (Fig. 48, A—D, p. 63).

The ***fibula*** is doubtfully indicated by three complete ones and numerous proximal and distal ends. Two of them are figured in 48 E and F. It is a rather broad and short bone, much broad and thin for an ordinary fibula. In outline it is not unlike the immature femur of *Shansisuchus shansisuchus*. A few isolated upper ends with well developed projection in loot at first glance like a tibia. It is, however, much weakly developed and the separation of the tibia and fibula condyles of the femur as clearly indicated in specimens of the named species, but missing here. We consider, therefore, that the here described bones are most probably to be determined as fibula. Its shortness and broadness are remarkable but fit rather well with the size of the tibia described above. It also fits with the rather stout lower arm of the present species mentioned above (Fig. 48, E—F, p. 63).

## Hand and foot bones

There are six bones illustrated in Figure 49 considered to be *metacarpals*. The short and broad ones are apparently the first metacarpal with rather thin proximal and comparatively thick distal end. Two of them are more obliquely outlined due chiefly to the lateral extension of the proximal end and medial extension of the lower distal end. The three other metacarpals are determined tentatively as III, IV and V respectively. They are more robust and both ends are strong built. They are too short for metatarsals. In average the referred hand bones are somewhat larger than the corresponding bone of *Shansisuchus shansisuchus* although the largest anterior limb of the present form exceeds not much the named species. In structure the hand bones differ considerably from that of Aetosauridae (Walker, 1961) by their comparatively shortness and rather comparable with the same bones referred to *S. shansisuchus* (Fig. 49, p. 64).

Some ball-shaped and large ***tarsal bones*** mentioned in the part of *Shansisuchus shansisuchus* may belong to this species. It is, however impossible to give a precise line of separation.

For the ***astragalus*** there is large one from 56159 (V. 2494B) especially interesting to mention. Since it is found in association with vertebrae and other bones undoubtedly belong to this form. It is very probable that it is pertaining to this form. It is a left one. In general, it is quite comparable with the same bone referred to *Shansisuchus shansisuchus* described above but differs from that of the mentioned form by the larger size, absence of the oblique ridge in dorsal view and istead there is a weak transversal one, the poorly developed medial end and the concave ventral side (Fig. 48, G, p. 63).

For the ***calcaneum*** there are two bones to be described here and at least one must belong to this species, if not two of them.

The one illustrated in Figure 34, C (p. 39) bears all the important features of the calcaneum of *Shansisuchus shansisuchus*. But it is very thick and no more plate-shaped. The both ends are somewhat shifted and the general quadratic outline is not so clear. Very peculiar is the structure of the anterior side which is not a flat concave surface but marked by a curious facet at the inferior side as shown in the top picture of the given figure. This is responsible for the sharp oblique ridge similar to the upper side of the astragalus. It seems in an abnormal connection with one of the distal tarsals. The both ends are distinctly twisted. This calcaneum as a little specialized one as compared with that of proper *Shansisuchus shansisuchus*. It is quite unlikely that it belongs to the named species and possibly pertaining to the present form.

The second calcaneum is also a right one. It is also quadratic in outline. As given in Figure 35, F (p. 40), the anterior surface is marked by a distinct shoulder at the median end. At the ventral side middle transversal ridge is formed from the lateral end inwardly forms a T-shaped outline in connection with the shoulders. Otherwise, it is a flat or weakly concave area separating by this ridge. Very interesting is the development of ball-shaped articular surface on the dorsal side, certainly for the contact of the fibula. The thin posteriorly extended lamella on the medial side, separating by a deep groove from the lateral end is merely an extension of the connected surface of the Astragalus and should not be mixed with tuber development of the other type of calcaneum of the pseudosuchian described below. The large triangular in outline median end is actually made of two surfaces, one is concave below the thin ridge is for the proximal row of tarsals and the other convex, somewhat above the concaved part for the real astragalus. This bone is certainly more specialized and complicated than the preceding described one. It is similar to the calcaneum of *Typothorax* and its related forms and thus more advanced. But it differs in many details from the mentioned forms so that it is still more primitive than that of upper Triassic genera. In general structure it is very hard to consider both as belonging to the same species. I tentatively consider this specimen as belonging to the here described form, while the preceding described one as an indication of another pseudosuchian not yet proved by other remains in our collection, or an abnormal specimen of *Shansisuchus shansisuchus*.

### Dermal scutes

*Shansisuchus shansisuchus* and the present new form are in most cases found together but the former represents by far the large number of individuals and the present form much less. The question arises to which one the relatively few dermal scutes belong. For the following reasons I referred the great part of the scutes to the here described form and a few ones to the other pseudosuchian described below, the *Wangisuchus* 1. The closest related form of *Shansisuchus shansisuchus* is *Erythrosuchus* which most probably bears no dermal scutes, although it is questioned by Kuhn (1961). 2. From the single locality 56173 over thirty

individuals of *Shansisuchus shansisuchus* have been found while only about five individuals of the present form were found from the same site and the dermal scutes are very poorly represented. 3. As shown below, the systematic position of the present form belongs to Rausuchidae, all members of which bear dermal scutes. And so on ....

Besides many fragments of doubtful scutes (some are not easily distinguishable from the broken pieces of skull roof) only about twenty are referred to this species. Most of them are illustrated in Figure 50. They may be classified in four groups. The first group (Fig. 50. A-G) is more or less quadratic or rectangular in outline with generally weak convex dorsal and concave ventral surfaces. The median border is marked by more or less thickened end apparently in loose connection with its opposite pair. With the exception of D and E which are too broken, the others show more or less distinct steep and more flat surfaces on the dorsal side. The former surface, when better preserved, shows rather coarse sculpture or pitted. It is the part exposed. The latter is smooth and is overlapped by its preceding one (p. 65).

Figure 50, A is nearly complete. It is a right side one. It is rather thin and the median thickened part is moderately developed. In the part below the thickened end there is a big oval imperforated foramen. Before this end and separated by a weak notch the bone there becomes slightly thicker and then thins out laterally. The posterior steep part is rough and sculptured. Laterally the bone bends downwards sharply. The ventral side is smooth and marked by a few faint grooves.

Figure 50, B is similar to 50 A but less complete. The median end is also weakly developed and the ventral foramen is smaller. It may belong to the same side as the last one.

Figure 50, C (from locality 5674, V. 2493A) is beautifully preserved in median part while the lateral part is broken away. The supposed posterior steep surface is marked by sculpture and pits. The median end is thick and triangular in outline. Before this another thickened part is formed as in 50, A. This represents evidently an adult individual.

Figure 50, D (locality 56160, V. 2700) seems to represent the posterior part of this sort of scutes. The surface is rather finely sculptured. Below the thickened end there is a deep depression as to indicate the vanished foramen. In the other end the bone bends clearly as in the case of 50, A.

Figure 50, E is still poorer in preservation. But it is clear that it represents the part of a scute similar to 50, A. The broader side represents the lateral border.

The specimen in Figure 50, F is quite different from all the specimens described above except its squarish outline. With the exception of one side which is interpreted as the posterior side all the other borders are more or less thickened. There is a notch in one of the corners, which is also rather thick. The dorsal side is marked by forked distinct ridge. The ventral side is weakly concave and smooth. This bone can be compared with the above described ones in sevaral respects but different from them also markedly as shown in the given figures.

Figure 50, G is a nearly complete scute, only the posterior(?) border is broken. It is also a broad rounded squarish scute slightly larger than the preceding one. It is with rather uniformly thin border besides the moderately thick medial end and the posterior lateral part. In addition the plate is sharply bent and separated by a transversal ridge with the steep side (posterior, and consequently the plate is a right one). This ridge extends anteriorly and laterally and the bone there is strongly vaulted. The bone is generally smooth before the transversal ridge and at the both sides of the oblique part of the ridge. The concave ventral surface is smooth. Beneath the median end and posterioly there is a depressed area. Seen from this side the named lateral thickened part is flat and faintly grooved as if representing an articular surface.

The second group is represented by specimens given in Figure 50 H-I. The most well preserved one

is I which is nearly complete. They are all transversally elongated with strongly developed median end. H and I are similarly built but different in size. In I (A left one, locality 56160, V. 2700) the median end is especially powerful and suddenly thins out laterally. And then it is marked by a weak constriction before it expands slightly. The posterior lateral part of the bone is damaged but its expanded rounded lateral border is doubtless. Besides the thick end there is a weak depression before the rather faint transversal ridge separating the bone into smooth anterior part and the steep poorly sculptured posterior part. In ventral side it is weakly concave. In this specimen it is clear that the narrow steeper side is overlapped by the preceding or next one.

The third group is represented by two scutes in natural position as shown in Figure 50, J. Medially the separation of the two is not so clear and may be coossified. The medial end anterior larger one is thickened and followed by very narrow constriction. Then the bone expands in a fan-shaped way. There is no actual ridge but a faint development of such can be observed separating the scute into two parts. The lateral anterior border is straight. The following scute is much smaller with no constriction near the base. It is also separated by the transversal ridge the posterior surface being steeper similar to the above described scutes. The median articular end is peculiarly formed with a deep almost vertical groove.

The fourth group is represented by a few pointed ones with triangular outline. They are shown in Figure 50, K–L.

Since all the different scutes mentioned above were found isolatedly and from various localities I do not attempt to determine the real position and the inter-relation of the few dermal bones. Nevertheless the following points are quite sure: They are quite different in structure from those of Aetosauridae including all the genera given by Walker (1961, 185). Certainly it is also from those genera of Erypetosuchidae (Newton, 1894). In all genera of the two families, the body is fully enclosed in armour and the scutes are rectangular in outline. In many respects it seems that the armour construction of the present form is not strong and the scutes are all laterally expanded even in group two. It is probable that the scutes belong to a form closely related or even belong to the family Rauiscuchidae represented by genera *Rauiscuchs, Prestosuchus* and *Stagonosuchus* and so on. The rounded lateral end of the scutes of the present form supports this assumption. In many points of the vertebrae and limb bones our form shows close relationships with the last named one of the genus *Stagonasuchus*. Unfortunately the scutes of this genus is unknown for further comparison. Although we fail to give the exact position of various scutes described above and to make a restoration of the whole dermal armour in place, it seems that the first and the second groups belong to the anterior dorsal part of the body and the third and the fourth to the posterior or tail of the body. I shall come back to the question latter in connection with the discussion of the next described form.

**Table 13. Important measurements of *Fenhosuchus cristatus* (in millimeters)**

**Premaxillary.**

| | |
|---|---|
| Height before the nasal opening (43, A) | 92 |
| Height near the anterior end (43, B) | 123 |

**?Lacrymal.**

| | |
|---|---|
| Length | 167 |

**Quadrate.**

| | |
|---|---|
| Specimen 43,D: Height | 219 |
| Width of the lower condyle 43, D | 72 |
| Lateral width of the proximal condyle 43, D | 23 |

**Vertebrae and ribs.**

| No. of vertebrae | Ventral length | Anter. breadth & height | Posterior breadth & height |
|---|---|---|---|
| 44, A | 37, 39 | 25×52; 38×65 | 41×63; 31×53 |

Width of the capitulum and tuberculum of the right rib attached to the first vertebra··········48

| | | | |
|---|---|---|---|
| 44, A' | 34; 37; ?38 | 36×?51; 43×63; 39×67 | 36×—:41×—:— |
| 44, C | 40 | 32×54 | 30×54 |
| 44, B | 26 | 36×57 | 37×50 |
| 44, D | 43 | 60×68 | 63×70 |
| 44, E | 42 | 49×59 | 51×57 |
| 44, F | 43 | 53×?51 | 53×66 |
| 44, G | 47 | 54×50 | 52×51 |
| 44, G' | 45 | 51×57 | 50×55 |
| 44, H | 44 | 54×55 | 52×57 |
| 44, I | 39 | 51×55 | 39×46 |
| 44, J | 38 | 54×69 | 55×69 |
| 44, K | 54 | 77×69 | 73×?84 |
| 44, L | 45, 42 | 77×57, — | —×75×49 |
| 44, M | 36 | 45×44 | 49×41 |
| 44, N | 29 | ?32×45 | ?33×42 |
| 44, O | 32 | 46×49 | 43×44 |
| 44, P | 48 | 39×45 | 42×47 |
| 44, Q | 38 | — | 26×42 |
| 44, R | 41 | | |
| 45, A | Breadth, 36 | medial height, 26 | external height, 63 |
| 45, B | Breadth, 46 | medial height, 37 | external height, 78 |
| 45, C | Breadth, 55 | medial height, 41 | external height, 79 |

**Pectoral girdle, and fore limbs.**

**Scapula,** 45, D. Length, 275··········; Prox. breadth, 123·········· Distal breadth, 99

**Coracoid,** 45, E. Distance of the scapula border, 106; Thickness of the scapula border··········51

**Coracoid,** 45, F. Scapular border, 113;·········· Thickness ··········51

**Coracoid,** 45, G. Scapular border, ··········84

**Humerus,** 45, H. Length, 295··········; Distal breadth, ·········· 128

**Humerus,** I. Length, 240, ·········· Proximal breadth, 77, Distal breadth, 126

**Humerus,** 45J. Length, 270,·········· Proximal breadth, 136, Distal breadth, 101

**Radius,** 46, A. Length, 150;·········· Proximal breadth, 77; Distal breadth, 54

**Ulna,** 46, B. Length, 210,·········· Proximal breadth; 79; Distal breadth, 60

**Ulna,** 46, C. Length, 26.·········· Proximal breadth; 120; Distal breadth, 59

**Pelvic girdle and posterior limbs.**

**Ilium,** 46, D. Breadth of the acetabulum, 126

**Pubis,** 46, E. Proximal breadth of the acetabulum border, 79

**Pubis,** 46, F. Length and breadth of the distal end, 76×49

**Ischium,** 46, G. Length and breadth of both, 40×36

**Femur.** 47, A. Length, 295; Proximal breadth, 84; Distal breadth, 75

**Femur.** 47, B. Length, 320; Proximal breadth, 84; Distal breadth, 88

**Femur.** 47, C. Length, 280; Proximal breadth, 75; Distal breadth, 75

**Tibia.** 48, A. Proximal breadth, 88

48, B. Proximal breadth, 93

48, C. Proximal breadth, 84

48, D. Presrved length, 240; Proximal breadth, 68; Distal transversal and sagital breadth 36×34.

**Fibula.** 48, E. Length, 265; Proximal breadth; 91; Distal breadth, 61

48, F. Length, 238; Proximal breadth; 87; Distal breadth, 59

**Astragalus,** 48, G. Breadth, 83;

?**Calcaneum** 34, C. Transversal breadth, 52

**Metatarsals.**

I 49, A. Length, 50; Proximal breadth; 40; Distal breadth, 39

I 49, B. Length, 45; Proximal breadth; 37; Distal breadth, 33

I 49, C. Length, 45; Proximal breadth; 36; Distal breadth, 33

III 49, D. Length, 82; Proximal breadth; 50; Distal breadth, 36

IV 49, E. Length, 65; Proximal breadth; 57; Distal breadth, 33
V 49, F. Length, 50; Proximal breadth; 42; Distal breadth, 25

**Dermal scutes**

50, A. Transversal breadth, 156; Medial length, 138
50, B. Preserved transversal breadth, 154
50, C. Preserved transversal breadth, 148; Maximum medial length, 186 Length and thickness of the median contact, 67×43
50, D. Preserved transversal breadth, probably posterior border, 150
50, E. Preserved transversal breadth, 149
50, F. Transversal breadth, 115; Medial length, 107
50, G. Transversal breadth, 119; Lateral max., length, 103
50, H. Transversal breadth, 110
50, I. Transversal breadth, 166; Medial length, 71; Medial thickness, 48
50, J. Transversal breadth of the anterior one, 105, the posterior one 79
Medial constriction of the first one, 12; Lateral length, 88
50, K. Tranversal breadth, 109
50, L. Tranversal breadth, 55

## II. DETERMINATION AND DISCUSSION

As already noted before, the material described in this section may include some bones which represent another species of the same genus. So far as we can judge at present all the bones seem to represent a quite distinct form compared with the previous described *Shansisuchus shansisuchus*. Both are quite close in dimension and both include rather larger and smaller individuals.

In the course of the preceding study, it has been made clear that in most part of the bones it is obviously different from the corresponding parts of the named form, such as the apparent absence of the first preorbital opening, the shape of the lacymal and the quadrate, the crested vertebrae, the special structure of the humerus and the long pubis and the ischium, the curved feature of the femur and the presence of the dermal scutes. Some other bones are not so clear, but also rather characteristic like the scapula, coracoid and the foot bones. Less clear are the ilium the fibula and the astragalus. In any way it is absolutely clear we have a quite new pseudosuchian in the collection of Shansi besides the two species of *Shansisuchus*.

The vertebrae of the present form show great similarities to *Stagonosuchus nyassicus* from Africa, concerning the keeled ventral and the lateral ridge behind the diapophysis. The sharp bending of the deltoid crest with the proximal end of the humerus, and the shape of the pubis and ischium are also closely comparable. There is no dermal scutes known in this genus for further comparison between the two forms. But the dermal scutes show that the present form is far apart from those with rectangular dermal armour such as *Aetosaurus* and its related genera. Therefore, our form can only be reasonably compared with those of laterally rounded scutes represented by *Rauisuchus, Prestosuchus* and so on. The other small pseudosuchians like *Ornithosuchus* and *Euparkeria* are too different in size and in structure for close comparison. It must be noted here also that all those genera noted above are geologically younger than our form. It is therefore, clear that we have to deal with a new form of pseudosuchian quite different from all the known genera. We propose to name it as *Fenhosuchus* gen nov. with the *Fenhosuchus criatatus* as the type species. Its diagnosis has been given above.

**Systematic position of the new form.** According to various parts of the skeleton and the structure of the dermal scutes, it is evident that our form is apart from Aetosauridae and closer to Rauisuchidae, both are belonging to the super family—Chirotheriodea (v. Huene, 1956). The superfamily Stagonolepoidea (Kuhn, 1961) according to Kuhn (1961), is includ the following families: Stagonolepidae, Aetosauridae, Desmatosuchidae and Rauisuchidae.

According to the recent study of Walker (1961), he has regrouped the genera formerly included in the families Stagonolepidae and Aetosauridae in the following way:

Aetosauridae:

*Aetosaurus, Stagonolepis, Typothorax, Desmatosuchus, Acompsosaurus, Stegomus*

Erpetosuchudae:

*Erpetosuchus, Dyoplax* etc.? Stegomusuchus.

From the present study, it seems that the family Rauisuchidae of v. Huene should exclude all the genera included in the above families and the combination of the families of Stagonolepidae, Aetosauridae and Desmatosauridae as done by Walker seems quite justified. If so, there is no other choice in regarding the present new form as a member of the family Rauisuchidae, unless it represents as a new family. Since the dermal scutes of our form are so peculiar, relatively short and broad with median foramen on the ventral side, poorly sculptured etc., the latter possibility can not be excluded.

Unfortunately the entire structure of the genera of the family Rauisuchidae, especially *Rauisuchus,* is incompletely known it is useless to go further concerning this question. It would be satisfied at present in regarding our form provisionally to the family Rauisuchidae of Huene.

**Paleobiological notes.** *Fenhosuchus cristatus* is a large beast. The largest specimens reach the size of the large ones of *Shansisuchus shansisuchus,* such as some vertebrae and the limb bones. It is only somewhat smaller than *Stagonosuchus nyassicus.* This form is relatively poorly represented in the locality 56173 and nevertheless a typical dweller in swamps as also indicated by the heavily-building limb bones.

The teeth of *Fenhosuchus* are practically unknown, probably quite different from those of *Shansisuchus* and similar to the other genera of Aëtosauridae, and certainly not so carnivorous as in the case of the former form. *Fenhosuchus* and all the members of Kannemeyerids in the fauna are the favorable diet and prey of *Shansisuchus.*

The dermal scutes of our form are poorly known, but most of their association with the vertebrae and postcranial skeleton seem out of question. We can prove it by many indirect evidences, although no actual connection of such was found. The dermal scutes, as noted above, are quite different in structure from those of Aëtosauridae. It seems that they are only sparsely developed. Certainly the body is not inclosed in scutes like *Stagonolepis* and other related forms. The development of the dermal armour of the present species indicates that instead of its relatively older horizon they are rather specialized. This conclusion is in accordance with the structure of the vertebrae, limb bones especially the astragalus and the calcaneum. *Fenhosuchus* represents apparently an aberrant form.

Nevertheless, it must be noted that the keeled and crested vertebrae, the curved femur, and the overlapping nature of the dermal scutes are features well indicated in many members of Parasuchia. It seems to suggest a close relationship of the present form with it, although the oldest known parasuchians *Mesorhinus* is found in the Lower Triassic with the nasal opening already shifted much backwards. Our form may be the closest form with the parasuchians among the Pseudosuchia. Some features of the upper and lower jaws support this idea.

**Pathological remarks** As repeatedly pointed out in the previous description, there are many pathological bones observed in the form under consideration. It is very clear and abundantly represented in the vertebrae. Nearly one third of the vertebrae are more or less abnormally developed. In general, one side (more frequently the right side) is more or less swollen and the parapophysis facet and the crest behind it are disappeared. In a few cases the both sides are asymmetrical. In the specimen given in Figure 44 B the right side is almost vanished and the parapophysis of the left side is pathologically developed. In 44,

E the parapophysis of both sides are shifted and quite asymmetrical. Since the specimen is so well preserved without any breakage it is hard to explain by distortion. Even in the specimen used as the type given in Figure 44, A', the diapophysis and the parapophysis of both sides are quite different, the right side being probably abnormal. The much larger vertebrae given in 44, K and L are also abnormal. In 44, K the depressions above and below the ridge are much excavated and both sides are asymmetrical with the both parapophysis facets shifted. It is unfortunately not able to make a reliable series of such pathological vertebrae, although many of them belong certainly to one individual.

In the limb bones such abnormal development is not seldom too. The coracoid in Figure 45, F with the peculiar depression on and the additional two holes on the other side may be considered as abnormal development. The humerus given in 45, I may be either somewhat distorted or pathological, or both. The ulna figured in 46, C is most probably a pathological one. The strange ilium (46, D) is certainly so. Although not so distinct, the pathological development is observed in most of the femora, as indicated by the quite different shapes of the proximal and distal condyles (47, A—C). It is also frequently observed in many of the unfigured specimens of the same bone. Such variation is also seen in *Shansisuchus shansisuchus* (Figure 31) but not so pronounced as in the present form. Figure 47, A is probably the normal one or nearly so. In the tibia, fibula and the foot bones such pathological development is not so clear, but may be indicated by Figure 48, D. the tibia; 48, G the astragalus and 49, A and C, the metatarsals I. The metatarsal III (49, D) looks also deceptive as a pure normal one.

Based upon the above observations, we must conclude that a great number of bones of *Fenhosuchus* are pathological. The reason for it is hard to explain. Probably it is caused by a sort of disease but also may be due to injure before death and subsequently recovered. Although armoured for defence, the life of *Fenhosuchus cristatus* with such beast like *Shansisuchus shansisuchus* must be very hard.

**Remarks on infant individuals .** As in the case of *Shansisuchus shansisuchus,* there are considerable number of bones of infant or juvenile individuals found in the collection, rather rare in vertebrae and more abundant in posterior limb bones. Sometimes it is hard to distinguish to which species they belong. In fragmentary specimens, even the determination of various bones is not sure. This fact indicates that the deposition of the strata, at least in the locality 56173, were laid down in rather quiet circumstance and object to the view that it was formed in torrential state.

The richness of the bone and mixed together with various creatures almost known at present suggest strongly that the deposits were formed by a sort of catastrophe and then transported from a not too far distance, if not near the original place they lived.

**Reconstruction of Fenhosuchus.** Since the skull of our animal is very poorly represented and the postcranial bones were found isolatedly, it is difficult to get the real proportions of different parts of the skeleton. Therefore, I do not attempt to make a reconstruction of the present, as did in *Shansisuchus shansisuchus*. It is, however, very suggestive that the general looking of our beast may be rather similar to that of *Prestosuchus* made by v. Huene.

## Super-family Ornithosuchoidea Hoffst. 1955

## Family Euparkeridae v. Huene 1920

## Genus *Wangisuchus* genus nov.

With the diagnosis of the type specics *Wangisuchus tzeyii.*

### *Wangisuchus tzeyii* sp. nov.

**Material.** Two left and two right maxillarae all from Hsishihwa, Lotzeyue, Wuhsiang, Lotzeyue, Wu-

hsiang (56173), form the type (V. 2701) and the co-types (V. 2702-V. 2704) of the present species (Cat. V. 2701-V. 2704).

The following specimens are the referred specimens from the same locality: Probably two lacrymals and one quadrate. 18 neck vertebra, at least 43 dorsal vertebrae of which a few are in natural connection; a few vertebrae figured in Fig. 54 are doubtfully referred here as presacral or anterior caudal vertebrae; a few sacral vertebrae three of which are belonging to the same individual and a few sacral ribs I and II; about 53 caudal vertebrae. Probably a left coracoid in connection with the proximal part of the scapula (apparently a young individual) and five isolated coracoids; two proximal and one distal parts of humerus; two radiis; a fragmentary ilium, four pubes and two ischia; three nearly complete femora and seven fragments of the same; twelve proximal and distal parts of tibia, many fragments of fibula; one astragalus, one calcaneum and a few foot (hand?) bones, a few scutes, smaller and quite different from those of the preceding described form are tentatively referred to this species. Besides, a few not closer determinable small bones are considered most probably to this form.

The above enumerated specimens fit in size and structure for a single species according to the study of the present author. But the possibility can not be entirely excluded that some ones may belong to some other form or forms not yet recognized.

The following spcimens are referred to the present species from localities other than 56173.

1. Chienkankou, Langwoshan N of Lotzeyue, Wuhsiang (56157). A number of partly consecutive dorsal vertebrae and fragmentary limb bones and traces of scutes belong probably to a single individual. V. 2705.
2. Peipanching, Shihpi, Wuhsiang (5523). Two broken isolated teeth, fragmentary limbs (one ulna is nearly complete) and part of the right hand in natural position. V. 2706.
3. Niukouyue, Lotzeyue, Wuhsiang (5535). One complete tooth and two ulnae. V. 2707.
4. A vertebra marked as Hsiaosunkou without other information V. 2508.
5. Tibia marked as Lungtukou without other information. V.2709.

Comparing with the other pseudosuchian found in Shansi the present form is rather poorly represented. In locality 56173 it is at most represented by five individuals. Its geographical distribution is also rather limited. It is only certainly known from Chienkankou and unknown from other places besides the Wuhsiang, Yueshe area.

**Horizon and locality.** Upper part of lower Triassic. Localities as noted above.

**Diagnosis.** Maxilla long and low with the posterior process pointed. The anterior border in connection with the premaxilla rounded. Certainly no second preorbital opening. The border of the preorbital opening is marked by a more or less distinct "shelf" as in the case of *Euparkeria.* Teeth typically sub-thecodont as in *Shansisuchus.* The badly preserved teeth as well as the isolated ones from 5523 and 5535 show that they are compressed and either lanceolated in shape or weakly curved backwards. They are poorly serrated. Vertebrae: Necks elongated. Dorsal moderately elongated with part of them possess thickened spinal dorsalis. Probably three sacral vertebrae. Limbs bone slender. Scapula slender. Coracoid foramen opened. Pubes short. Ischium with long shaft. Femur slender and S-shaped curved. Calcaneum with tuber. Hand and foot bones rather less stretched.

## I. DESCRIPTION

### Skull remains (Fig. 51, p. 70)

Maxillae. There are two left and two right maxillae preserved. The adult and the most complete one (V.2701) is selected as the type. The right one, also adult is smaller than the type. The two other left

and right maxillae are less adult in age and quite different in size. It is therefore that the four maxillae represent four different individuals.

The type specimen (Fig. 51, A) is mostly completely preserved, with the damage of the upper process near the anterior end. It is practically complete. Total length 111 mm. Anterior height 35 mm. Middle height, 21 mm. Thickness across the anterior part behind the upper process, 11 mm. The lower border along the teeth row is nearly straight. The bone narrows from the anterior part very gently up to the point about 24 millimeters before the tip and then reduces in height suddenly in order to form the posterior tip. The part between the upper process and the root of the tip forms the lower border of the preorbital opening while the remaining part with the tip is in connection with the jugal. Although the "shelf" along the border is not so pronounced as the other maxillae due probably to its rather older age but it is clearly recognizable. The anterior end is obtusely rounded. It differs from the other known pseudosuchians by the more vertically developed border certainly in contact with the premaxilla and the more steep slope of the upper part which is in connection with the nasal. Whether it makes the part of the nasal opening is not sure, probably not, as in the case of most of the pseudosuchians. The inner side is slightly convex, the outer side is nearly flat. The dentition of the type is poorly shown. But it gives the number of the maxilla teeth pretty certain on account of its completeness. It is probably 13 in number at most 14. Although damaged, the zigzag alveolar border, as it is better shown in the other specimens, is clearly recognizable. The fourth tooth and sixth and seventh counting from behind are with the base part actually preserved. They show the same compressed nature as the isolated teeth to be described below. The dentition is sub-thecodont and isodont and thus differing remarkably from that of *Chasmatosaurus.*

The right maxilla (V. 2703) is hardly the same individual, as it is decidedly smaller. Only part 55 mm. from the anterior end is preserved. It is somewhat deformed and the outer flat surface became convex. The upper process is better preserved and the "shelf" along the border is clearly developed.

The other left maxilla (V. 2702) is also well preserved as the type but the posterior part being missing. The upper process is well preserved, only the end is broken. In all the observed features, it agrees well with those of the type. The size is somewhat smaller. Height behind the upper process, 20 mm. The part of the posterior end, short before the breakage, is slightly more high (21 mm.), forming the posterior lower corner of the preorbital opening. The "shelf" along the border is quite distinct. There are about 10 teeth sockets between the zigzag bony plates along the alveolar border.

The fourth maxilla is a right one (2704). It is certainly a young individual. The upper process is only vestigially developed. The posterior part is borken. There are seven teeth sockets shown, only the sixth one counting from anterior end shows the base part of the sharply compressed tooth. Height behind the upper process, 20 mm; near the posterior breakage, 12 mm.

Although different in size, all four maxillae show essentially the same features, especially the structure of the dentition the deepening of the preorbital border and the straightness of the central border. No doubt they represent the same species.

**? Lacrymal.** The bone given in Figure 51, E is doubtfully referred here as the lacrymal. The size looks fit with this form. Total length 113 mm. It is apparently a right one. The anterior upper extension so well developed in many of the pseudosuchians is missing in this specimen. It may be the postorbital but the proximal end is quite different. Without new better specimen, the question can not be settled at present. A second much smaller one with the proximal end broken represents the same kind of bone.

**Quadrate.** A distal articular part of a right quadrate is shown in Figure 51, F. Breadth of the distal end 25 mm.

**The teeth.** There are five isolated teeth (Fig. 51, G—K) one of G from 5535; H and I from 5523 and J and K from 56173, are considered to be belonging to the present species. The last named one 51, K may be too large for the present form, all the other ones fit in size with the above described maxillae. They are sharply compressed. In the smaller ones the serration is not so well developed but better shown in the larger ones J and K. In comparison of our teeth with those of *Chasmatosaurus ultimus* of Shihpienkou, 5537 they are less backwards curved, otherwise they are quite similar each other. It is not sure to decide the exact position of the tooth now.

## Vertebrae

Since most of the vertebrae were found isolatedly, it is not sure concerning their exact position. Their pertaining to this species seems doubtless, as they are much smaller than both *Shansisuchus shansisuchus* and *Fenhosuchus cristatus* and also distinctly smaller than *Sh. heiyuekouensis* described above. With the exception of a few specimens, all are about the same size. In addition they are characterized by many features. Therefore we consider that all the here described vertebrae belong to this species, although it is possible that a few of them may be excluded.

**Neck vertebrae.** There are 14 neck vertebrae five of which are illustrated in Fig. 52 A—E. All of them are more or less weakly amphycelous and elongated and either longer than or sub-equal to the dorsal vertebrae. In many of them the parapophysis is preserved and situated quite near the base of centrum. The lateral side is more or less excavated. The ventral side is either grooved at the anterior part and distinctly constricted or sharply keeled. The former ones belong to the anterior part of the neck and the latter to the posterior part. The neural arch is in most cases obscure and incomplete as shown in the given figure (p. 71).

If it is correctly determined, the present vertebrae are characterized by their elongation similar to those of *Chasmatosaurus* but without intercentrum, same as those of *Fenhosuchus*.

**Dorsal vertebrae.** The dorsal vertebrae are comparatively richly represented (Figs 53—54). But the anterior dorsals are rather rare. Their exact position in the column is difficult to determine. They are about the same length or even slightly shorter than the neck vertebrae but longer than the posterior dorsal vertebrae. The centrum is more robust and less constricted without trace of keel or groove on the ventral side. In a few of them the neural arch is preserved. In Fig. 53 A and B the position of the parapophysis lies rather low on the anterior lateral side of the centrum and must belong to the part near the pectoral girdle, while in Fig. 53 C—F, it is shifted upwards and in confluence with the diapophysis and belong to the rather middle part of the column. The distal part of the spina dorsalis is more or less thickened (p. 72).

The posterior dorsal vertebrae are represented by numerous isolated ones but the better preserved pieces are one with three and the other with five in natural consecutive order which are shown in Fig. 53, M and N. The centrum of them is much elongated and constricted in the middle. The parapophysis is usually no more visible or in close connection with the rather short and downwards directed diapophysis. The dorsal spine is rather low with well developed distal end as in the case of the anterior dorsal vertebrae. In the locality of 56157 (2705) a few consecutive posterior dorsai vertebrae show essentially the same features as the here described ones, only the dorsal spine being a little longer. They belong certainly to the same species.

A few rather abnormally developed vertebrae shown in Fig. 54, A—E. They are larger than the lumbar vertebrae described above and furthermore differ from them by the either unequal size or more amphicoelous ends of the centrum, the ventral side may be grooved or keeled. They are probably pathological and ten-

**Table 14. Measurements of the vertebrae *Wangisuchus tzeyii* (in millimeters)**

| | Ventral length of the centrum | Height & breadth of Anterior end of the centrum | Height & breadth of posterior end of the centrum |
|---|---|---|---|
| Neck: | | | |
| 52, A | 35 | 20×16 | 19×16 |
| 52, B | 32 | 15×15 | 16×13 |
| 53, C | 24 | 19×18 | 18×15 |
| 52, D | 23 | 18×18 | 19×14 |
| 52, E | 24 | 16×15 | 17×16 |
| Dorsal: | | | |
| 53, A | 21 | 21×23 | 25×23 |
| 53, B | 26 | 22×27 | 21×23 |
| Posterior height from lower margin of the centrum to dorsal spine ······45 | | | |
| 53, C | 21 | 24×25 | 23''' |
| Posterior height including the dorsal spine ······58 | | | |
| 53, D | 19 | 18×18 | 18×18 |
| 53, E | 24 | — — | 25×27 |
| 53, F | 26 | 24×23 | 25×24 |
| 53, G | 27 | — — | 24×23 |
| 53, H | 24 | 18×13 | 19×13 |
| Posterior height including the dorsal spine ······46 | | | |
| 53, I | 28 | 20×21 | 20×20 |
| Posterior height including the dorsal spine ······51 | | | |
| 53, J | 26 | 16×17 | 21×16 |
| 53, K | 30 | — — | 24×18 |
| 53, L | 31 | — — | 13×16 |
| 53, M Total length of the three vertebrae······84 | | | |
| 53, N Total length of the five vertebrae ······137 | | | |
| Transversal thickness of the end of the dorsal spine of the first vertebra ······19 | | | |
| 54, A | 29 | 23×— | 31×28 |
| 54, B | — | — — | 31×34 |
| 54, C | 34 | 30×25 | —×43 |
| 54, D | 36 | 27×31 | 35×32 |
| 54, E | 37 | 30×30 | 36×27 |
| 54, F | 31 | 26×24 | 26×23 |
| Posterior height including the dorsal spine ······65 | | | |
| Sacral and caudal vertebrae: | | | |
| 55, A | 27 | 27×24 | 22×25 |
| 55, B | 54 (two) | 26×22 (anter.one) | 22×21 (post. one) |
| Posterior height ······62 | | | |
| Sacral rib (C) | | | |
| Maximum length······44; proximal breadth······28; distal breadth······37 | | | |
| ?Sacral rib (55, C) | | | |
| Maximum length ······37; proximal breadth ······31; distal breadth,······37 | | | |
| 55, D (Sacral I) | 27 | 18×22 | 21×20 |
| 55, E (Sacral II) | 25 | 16×23 | 15×19 |
| 55, F (Sacral III) | 24 | 16×17 | 15×13 |
| 55, G | 26 | 26×26 | 27×24 |
| Posterior height including the dorsal spine ······59 | | | |
| 55, H | 26 | 20×23 | 22×21 |
| 55, I | — | 23×21 | —×— |
| 55, J | 23 | 21×23 | 22×24 |
| 55, K | 25 | —×16 | 19×16 |
| 55, L | 21 | 17×13 | 14×12 |
| 55, M | 22 | 20×15 | 18×15 |
| 55, N | 21 | 19×12 | 18×12 |
| 55, O | 21 | 11×9 | 13×9 |
| 55, P | 12 | 9×9.5 | 11×8.5 |
| 55, Q | 14 | 13×24 | 10×16 |

tatively referred to this species. The vertebra given in Fig. 54, F is a larger and the distal end of the dorsal spine is not quite thickened, diapophysis being probably broken. It may belong to the lumbar or to caudal vertebra (p. 73).

With the exception of the one (Fig. 54, D) all the dorsal vertebrae are platycoelous.

As shown in Table 14 the size of all the vertebrae is rather uniform and close each other. There are few unfigured small ones but the difference is slight (p. 175).

**Sacral vertebrae and sacral ribs.** The sacrum is composed most probably of three vertebrae as shown in Figure 55 A and B. They can fit rather nicely to consider A as sac. I and B as sac. II and III. But the different colorations (A greyish and B light yellow) show that they belong to two different individuals. Fig. 55, A is most probably the first sacral vertebra. The centrum is less constricted. The diapophysis of the right side is well preserved with very thickened distal end. In B the first vertebra is more constricted as the preceding one. The end of the dorsal spine of both is preserved. That of the left one is more thick than the right one. The expanded diapophysis is co-ossified., the posterior part being damaged. The two vertebrae are also co-ossified indicating that it is an old individual (p. 74).

The first right rib (55 B) is similar to the first sacral rib of *Shansisuchus shansisuchus* but much smaller and narrower. The other sacral rib illustrated in Fig. 55 $C_2$ is rather peculiarly shaped. It pertains probably to the middle sacral vertebra, as its proximal end fits rather well with the above described specimen B.

A few better preserved sacral vertebrae are figured in D, E and F. The former is I and latter III.

Although the sacral vertebrae and sacral ribs are represented by numerous specimens, some important points of the structure of this part of the vertebral column remain obscure.

**Caudal vertebrae.** Nine vertebrae of the tail are illustrated in Fig. 55 G to O. G—I are the anterior immediately after the sacral, J anterior middle and the others are posterior ones. G is most completely preserved with the ventral side broadly grooved and shows clearly the facet for the attachment of the chevron. The diapophysis is pyramid-like and the dorsal spine is without of thickening short. This vertebra may lie very close to the last sacral vertebra. Fig. 55 H and Fig. 55 are similarly built as in 55. G but the ventral side of the centrum is not grooved but rather narrowly compressed. The centrum of J is broad and no constriction and may lie rather posterior in position as the preceding ones. The diapophysis is reduced and directed upwards. The other vertebrae are more elongated and typical in every respect like the posterior part of the tail.

The vertebra figured in Fig. 55, P is probably juvenile specimen. It is from 5523 in association with a few limb-bones referable to the here described species. Its ventral side is grooved and its position is not sure, probably a tail vertebra.

The other vertebra from 56173 given in Figure 55, Q is certainly not belong to this species. It is characterized by the difference of the centrum ends. The anterior end is larger than the posterior one. It is figured here for indicating that some sorts or members of animal remain still unkown in the locality of 56173.

## Pectoral girdle and anterior limbs

**Scapula and coracoid.** No sure isolated scapula is present. In the right scapulo-coracoid (Fig. 56, A) the proximal part of it is preserved. There is very little to say about its structure. Breadth along the coracoid border 43 mm. The contact with the coracoid is firmly co-ossified. The glenoid surface is well formed but almost wholy concealed in inner view, its joint line can be traced faintly (p. 76).

The ***coracoid*** is sub-quadratic in outline and rather thin. The coracoid foramen is quite near to the

scapula border. Anterior posterior length 49 mm; breadth perpendicular to the scapula border, 34 mm. At first glance this scapulo-coracoid seems to represent a rather young individual, despite of the fixed nature of the two bones.

There are two right and three left isolated coracoids, though more or less damaged along the border, may be referred to this species too. One of the median sized specimen is shown in Fig. 56, B, which is nearly complete. It differs from the above described specimen by the large opened coracoid foramen. In the five specimens there is one with the foramen closed. The general shape of the bone resembles to that of *Stagonolepis robersoni* although it is one half smaller.

**Clavicle(?).** Two right clavicles are present (Fig. 56, C and D). One with the proximal end damaged but the distal end is almost complete. The proximal end of the other specimen is better preserved but the distal half is missing. The bone is almost too straight for a clavicle, only the proximal part shows the main curvature. Proximal breadth, 39 mm; distal breadth, 12 mm. It seems too large for the present form. Its pertaining to other form such as *Shansis. heiyuekouensis* can not be excluded. Both bones are certainly young individuals, which make difficdlt for a same determination.

**Humerus.** Proximal part of a left one, a right one and a distal part of the right side are preserved (Fig. 56, E—G). The size fit rather with the scapulo-coracoid described above. The proximal breadth of the left 67 mm; distal breadth of the shaft near the breakage, 13 mm. The condyle is well developed. The deltoid crest is poorly developed. The proximal end is more expanded like the other forms described in this paper. Its constriction towards the distal direction is very rapid. The other right one is essentially the same appearance but smaller. Proximal breadth 56 mm. The distal part of the humerus is expanded. Breadth near the end 56 mm. Breadth of the shaft near the breakage, 14 mm. It seems that the humerus of the present form is an expanded one and not at all slender as in the case of *Hesperosuchus* but more like that of *Shansisuchus* and *Fenhosuchus*. The middle part is comparatively very much constricted. Although the two parts of the right humeri are proofless to be of one individual but the length of them may give an estimated value of the bone that is about 164 mm which is only slightly longer than one of the femura referred to the same form but shonter than the other one. Obviously our form is a quadrupedal animal not like that of the latter ornithosuchids.

The proximal and the distal part of another left humerus figured in Fig. 56, H and I are very problematical. They may belong to one specimen but the middle part is lost. They are much smaller than the above described humeri. Instead of its smallness the proximal condyle is rather robust. It may belong to a young individual or some unidentified forms.

**Ulna.** The presence of this bone in our collection is still obscure. There are one proximal end and one distal end which are smaller than those of *Shans. heiyuekouensis*, but too incomplete for worth to describe here.

**Radius.** The two radii figured in Fig. 57 A and B from 56173 are rather different in dimension. B is much thickly built and A is slender, the former may belong to a young one on account of its slenderness. Both appear to be the right side. The specimen given in Fig. 57, C from 5523 is probably a radius too. It is still more slender than the other one but almost the same length. It may belong to a younger individual too. Total length, A, 102; B, 97; C, 102 mm. Proximal breadth, A, 30; B, 35; C, ?23. Distal breadth, A, 29; B, 33; C?17 (p. 77).

**Hand bones.** There is no carpal bone preserved. From 5523 a connected right hand is well preserved (Fig. 57, D). The Mtc. I—V are in natural position, only the Mtc. V is sidewards somewhat displaced. Part of I and distal part of IV and both ends of V are damaged. They are slender. Mtc. I is compara-

tively robust. They are decreased in slenderness laterally. Mtc. II and III are equal in length. Mtc. V is especially small, only slight trace of proximal expansion. On the whole, the metacarpalia are primitive in appearance. Total proximal breadth of Mtc. I—IV, 33 mm. Length of I—V, 36, 38, 31 and 28 respectively. Proximal and distal breadth of Mtc. I, 11 and 9 mm. Immediately below Mtc. I phalangx, apparently of Mtc. I is badly preserved, mostly by impression except its distal part. Length, 17 mm; distal breadth, 8 mm. An another phalanx is seen a distance direct below IV but most probably the first phalanx of Mtc. III. It is not quite complete, length about 15 mm. Since the other bones of this locality appear to be of a immature individual, these hand bones must be corsidered as belonging to a young animal too.

### Pelvic girdle and posterior limbs

**Ilium.** Only one right ilium is present (Fig. 57, E). The part above the accetabulum is badly damaged, but the root below the posterior extension can be traced. The acetabulum is not perforated, although its lower border is damaged. It is almost a little too large for the head of the femur described below. Breadth above the acetabulum, 51 mm; Breadth across the acetabulum 56 mm (p. 77).

**Pubes.** There are two left and one right pubes. They are very peculiar in nature. They are extremely short and broad with the distal end more or less thickened (especially so in the figured specimen) (Fig. 58. A). The facet with the ilium is fairly flat. The two well formed pubic foramina are small and closed. Proximal breadth, 50 mm; Maximum length 59 mm; Length of the ischium border 35 mm. Maximum thickness of the proximal end, 18 mm, of the distal, ?23 mm. The other two non-figured specimens are somewhat smaller and less thick.

**Ischium.** This bone is represented by a complete left and two proximal parts of right one (Fig. 59, A). Contrary to the shortness of the pubes this bone is with a long shaft. If it is correctly determined, the structure of the pelvic girdle is very much like that of *Euparkeria*. The ischium of our form is however more slender. The proximal part is considerably expanded. The anterior border is somewhat broken so that the bone is actually broader than is given in the picture. The acetabulum border is thick and the pubic border is broken. The bone narrows gradually distal wards before a weak constriction above the distal end, which is triangular in outline. The median side is covered by hard matrix which is purposely left intact for reinforcement. Total length, anterior, 139, posterior, 115 mm. Proximal preserved breadth, 63 mm.; breadth of the distal end, 29 mm. The other two right ischia are about the same size. In one of them the shoulder between the acetabulum and pubic border is well developed. The pubic border is a little better preserved (p. 80).

Although there is little doubt left that the three elements of the pelvic girdle pertain to the same form, a reliable reconstruction of it is difficult to make, chiefly due to the incompleness of the ilium. On the whole as pointed above the pelvic girdle of the present form foreshadows that of the *Euparkeria* of approximately the same age.

**Femur.** There are five left, one right and some fragments of femura indicating that in the locality 56173 we have to deal with at least five individuals. Only one (Fig. 58, B) is complete. Fig. 58, C is also complete but somewhat distorted. The other one Fig. 58, D is distorted in distal portion and the proximal end is lost. The other specimens are represented by distal part only. In lateral view, the femur is S-shaped curved. It is rather similar to the femur of *Hesperosuchus* (Colbert, 1952). Our form is slightly longer than that of the named genus, but more slender in the middle part which is rather thin, so that the both ends look more expanded. The fourth trochanter lies quite near the proximal end. The other two femora repeat the essential characteristics of the best preserved one and differ only in minor features. The

distorted part of both specimens shows that the wall of the bone is thin as attested by the fragments shown in cross section. Total length of 58, B, 161, 58, C, 170; Proximal breadth of 58, B, 33, 58, C, 37; Distal breadth of 58, B, 29; 58, C, 36 (deformed). Cross section at the middle 58, B, 8 ×17; 58, C, 10×16; 58, D, 12×19 (all in milimeters (p. 79)).

The present femur looks almost too small for the above described humerus, it is subequal or only slightly longer than the named bone. But the general association of all here described elements leaves little doubt (with a few exceptional ones as noted above) that a second pseudosuchian may present in the fauna. A fundamentally quadrupedal mode of life of our animal must be tentatively accepted.

**Tibia.** It is represented by numerous fragments, none of them is complete. A most complete one, a proximal and a distal end are figured in Fig. 59, B—D. The one with complete proximal end is the right while one with the distal end is probably the left side. The better preserved specimen may belong to the right side too. Comparing to the slenderness of the femur, the tibia is rather strong and robust. The proximal end shows that the cnemial crest is poorly developed. The tibia looks more long stretched and slender than that of *Shansisuchus shansisuchus*. Its total length is estimated as no less than 180 millimeters. The better preserved one with the proximal end partly intact. It narrows gradually distal wards and then beginn to expand slightly which shows that it is near to the distal end. This specimen has a preserved length 166 mm. In any way, the tibia is considerably longer than the femur. Anterior posterior medial length of the proximal end of 59, C 41 mm.; breadth of the same 34 mm. Length and breadth of 59, D 33 and 24 respectively. The breakage of the bone shows that the bone wall is also very thin, indicating that the association with the femur is correct (p. 79).

**Fibula.** Many fragments of this bone are at disposal but none of them is comparatively complete. Two fibula from the locality 5523, probably the proximal end (Fig. 59, E and F) and three from 56173 are the distal ends (Fig. 59, G—I). The last one, more broad and large, is doubtfully referred here. The both ends of the fibula are comparatively thick. Total length unknown. Proximal breadth and length in millimeter: 59, E, 15×19; 59, F, 13×19; Distal breadth and length: 59, G, 12×19; 59, H, 15×18; 59, I, 17×27. The non figured fragmentary fibula are too poor for any worth while description.

**Astragalus.** A left astragalus figured in Fig. 34, D is referred to this species by its smallness and structure. It is very similar to the bone which was erroneously determined as the calcaneum of *Chasmatosaurus* (Young, 1936). The lateral side is narrow and high with the facet in contact with calcaneum while the median side is considerably expanded. The dorsal side is slightly concave. A deep fossa with a transversal groove below it can be observed in anterior view. This bone differs remarkably from that of both *Shansisuchus* and *Fenhosuchus* and rather similar to that of *Euparkeria,* only the lateral end being more narrow. Transversal breadth, 38 mm; Lateral height, 25 mm.; median anteriorposterior length, 30 mm. The plate-shaped nature of the bone indicates the rather primitive stage of development (p. 39).

**Calcaneum.** A right one is present (Fig. 60, A) Contrary to the rather primitiveness of the astragalus, the calcaneum is decidedly specialized. It is formed in the same way as that of *Episcoposaurus* and *stagonolepis* (Huene, 1915, P. 495). It is however much longer in the present form. The tuber or process is well developed. Length, 28 mm.; Breadth, with the tuber, 23 mm (p. 81).

The calcaneum is so advanced in structure that its real belonging to the here described form may be questioned. The size fit however and the calcaneums of the various forms described above are all quite different in structure. It is therefore very probably that the both bones are from the same animal and such combination may be considered as a characteristic of the present form.

**Metatarsalia.** A few complete metapodials are figured in Fig. 60, B—C. In addition, there are two

proximal parts of them. From the locality 5535 a nearly complete Mt. III or IV is given in the same figure. Those from 56173 represent probably the Mt. I, Mt. II, Mt. III and Mt. V from left to right in the given figure. The first one looks somewhat too small for being Mt. I. All the metapodials are slightly robust and larger than those of *Chasmatosaurus yuani* from Sinkiang. They are also very similar too, but the both ends are more expanded in comparison with those of *Euparkeria,* our form is much larger and the both ends are broader and stronger. They are more than two times larger than the named species. The fifth *metatarsus* is proximally broadening with rather strong distal end. The only metatarsus from 5535 looks broader for Mt. III or IV. due to slight distortion. Its proximal end is damaged and distal end worn by erosion. Nevertheless, the general structure makes the determination doubtless. Length, proximal breadth and distal breadth of Mt. I, 40 mm., 23 mm., 18 mm.; of Mt. II, 66, 38, 27; Mt. III, 73, 28, 17; Mt. III or IV (5535) 79, 28, 22.

No sure presence of phalanges in this species.

### Dermal scutes

It is no doubt that the present form bears dermal bones as indicated by the strong thickening of the dorsal spine of the vertebrae. Actually there are a number of dermal scutes so peculiar in shape that we can not refer them to the *Fenhosuchus* without hesitation. But they look almost too large for being this species. In addition their position and arrangement to the body are quite obscure. In some of them the possibility of pertaining to the above metioned form or other unknown pseudosuchian in the collection is not absolutely excluded.

The scutes here described may be grouped into three groups (p. 82):

1. Large oval ones (Fig. 61, A—D). They are more or less oval in outline with one side considerably thicker and the other side thinner. They are all concaved in one side and convex in the other. The surface on both sides are smooth and no trace of any sculpture. It is possible that the convex side represents the outer side. The length of the largest one (Fig. 61, C) is estimated about 120 mm. and the breadth, 82 mm. It reaches the median sized scute of *Fenhosuchus,* but quite different in structure.

2. Smaller and transversally elongated ones (Fig. 61, E—F). The both ends of this group are thickened the narrower end is probably the medial side and the broader the lateral side. In E, the presumably outer side is convex and the other side is concave. But in F, the inner side is fairly flat. They may belong to the anterior caudal part of the body. Length, proximal and distal breadth of E, 80, 41 and 57; F; 75, 42, 45 mm.

3. Small and pointed ones (61, G—H). These two scutes are especially interesting because they were found together with the vertebrae referred to this species. They are small with the median articulated end thick. They are triangular in outline with lateral sharp point. The outer convex side is weakly sculptured while the inner concave surface is smooth. They are evidently belong to the lateral marginal. Transversal breadth of G, 7, 35 mm H, 43 mm.

## II. DETERMINATION AND DISCUSSIONS

The four maxillae described above are sufficiently characteristic. They differ remarkably from those of the two genera described in the preceding pages. It is also quite obvious that most of the post cranial bones are referable to the bones of the skull, although some of them may be doubted. They are fit in size and structures especially the vertebrae and most of the limbs. Sometimes, it is difficult to make a sharp line between the smaller specimens of the *Shansisuchus heiyuekouensis* and the present form. But on the whole we must consider that our new form represented good anatomical unit.

The maxillae indicate at first glance some similarities to *Chasmatosaurus* and the long stretched neck vertebrae support this assumption. But a closer study of the bones excluded this idea. The teeth of our form are sub-thecodont and the dorsal spine of the vertebrae are thickened, characters prevent any further comparison with the primitive proterosuchians.

It is equally obvious that our form need not to compare seriously with the scuteless elachistosuchians, the highly armored stagonolepoidians. Our form is thus most probably a member of the Ornithocuchoidea in the sense of Hoffstter (1955). In the course of the description we have compared in some points with the genus *Euparkeria*. It seems quite sure in referring our form to this family. The shape of the maxilla with the characteristic deepening along the border, the general form of the pelvic girdle support this assumption. Our form is much larger than *Euparkeria*. In addition, a series of features differ remarkably from those of the named genus such as the long neck vertebrae, the well development of the thick end of the dorsal spine, the shortness and the thickening of the pubes and apparently more peculiar features of the dermal scutes. Obviously we have to deal with a new form of Pseudosuchia for which we like to propose the name *Wangisuchus tzeyii* new genus and new species with the diagnosis already cited above. The name is dedicated to Mr. Tze-yi Wang for his laborious work in exploring fossils of vertebrates.

Although the association of various bones is not surely known and also different in age, we try nevertheless to deduce a few figures and ratios just as a hint for the proportions of the body.

Estimated by the length of the maxilla, the length of the skull must be no less than 220 mm long. It is thus a median sized animal.

The exact number of the vertebrae is unknown but probably neck, 10; dorsals, 25; sacral, three and caudal 50 or more; total length estimated: about one meter and a half long.

**Table 15. Estimated ratios of *Wangisuchus tzeyii***

| | |
|---|---|
| Radius/humerus (102/164) | 62 |
| Metacarpal/humerus (38/164) | 23 |
| Tibia/femur (166/161) | 103 |
| Metatarsal/femur (73/161) | 45 |
| Humerus/femur (164/161) | 11.8 |
| Fore limb/hind limb (164 + 102 + 38/161 + 166 + 73) | 76 |

To compare with the various corresponding ratios given by Colbert (1952) for genera of Ornithosuchidae no one can be regarded as closer to our form. The present form is evidently excluded from this family.

The limbs of *Euparkeria* are so poorly known that any such ratio is not available.

As far as we can observe from the various parts of the bones it is safe to say that *Wangisuchus* represents a much specialized form among the Ornithosuchoidea as indicated by the strong dorsal spine, increase number of the sacral vertebra, very specialized coracoid and pubes. The dermal scutes are also very special. They are not so strongly developed as in the case of stagonolepids but much better so than *Euparkeria*.

Nevertheless, the present form bears a number of primitive characters, such as the relatively long anterior limbs poorly developed dermal scutes and the lengthening of the neck vertebrac etc. Therefore, *Wangisuchus* can be regarded as a form with mixed advanced and primitive features. It would be no wonder that the present form represents the type near to the ancestrals of the late Triassic ornithosuchids.

The length of the tibia over that of the femur and the thin bone walls of all the limb bones may suggest a close relationship between the present form and the latter Coelusosaurs. Although the anterior limb is

relatively long but the tendency of bipedalism begins certainly already (even more than in *Shansisuchus shansisuchus*).

As suggested by the dentition and the slenderness of the limbs, *Wangisuchus* is certainly a carnivorous animal living chiefly in highland. It is much more swift and active than *Shansisuchus*.

# CONCLUSIONS

## Composition of the fauna

Pseudosuchians are richly represented in the *Sinokannemeyeria* fauna of Shansi. With the exception of the so-called *Chasmatosaurus yuani* (to be redescribed as a new species and discussed latter), all of them were described in the previous pages. The pseudosuchian of Shansi may be listed below:

**Table 16. List of pseudosuchians known in the Triassic Beds of Shansi**

| | |
|---|---|
| Super-family Proterosuchia Broom. 1911 | |
| Family Proterosuchidaeca v, Huene. | |
| *Chasmatosaurus ultimus* sp. nov. (*Chast. yuani* of Shansi). | Shihpienkou (5537) |
| Family Shansisuchidae fam. nov. | |
| *Shansisuchus shansisuchus* gen et sp. nov. | |
| *Shansisuchus heiyuckouensis* sp. nov. | |
| | Localities as noted above. |
| Super-family Chirotheriodea v. Huene | |
| Family ?Rauisuchidae Huene | |
| *Fenhosuchus cristatus* gen. et sp. nov. | |
| | Localities as noted above. |
| Super-family Ornithosuchoidea Hoffstter | |
| Family Euparkeridae Huene. | |
| *Wangisuchus tzeyii* gen. et sp. nov. | |
| | Localities as noted above. |

With the exception of the important family Sphenosuchidae and the poorly known Elachistosuchoidea all the main groups of Pseudosuchia are represented in the fauna. Besides the genus *Chasmatosurus* which is represented by a unique specimen,, all the others are very rich in individuals and rather widely distributed.

Therefore it is obvious, that the present pseudosuchian fauna represents the richest and widely distributed sub-order of the Thecodantia so far known.

## Vertebrate remains from various Triassic localities in Shansi

Before we are going to discuss the relationships of the whole fauna, it is necessary to give a view about the various fossils according to localities. With the exception of the Labyrinthodonts, all the fossils from Shansi are now described, so that it is possible to make a census of the fauna. The remains of the Labyrinthodonts, are very poorly represented and very probably belong to the family capitosauritae, one species only (See foot note, p. 118).

In the above enumerated fossils the two forms of Lincheyue *Paoteodon huanghoensis* Chow and Sun (1960) and *Ordosiodon lincheyueensis* Young (1961) are not included. The geological condition of this place is not quite clear. But since the level *Neoprocolophon asiaticus* is from the third fossiliferous Beds and that of the two named genus is close to the top of the Shihtienfen Series, if not still lower, as observed by T. Y. Wang, it is hardly believable to assume that they were derived from the Ehrmayin Series[1]. But

1) According to field observation of T. Y. Wang the Lincheyue Beds represents the top part of the Shihtienfen Series.

as soon as can be judged from the paleontological documents, it seems that the level bearing the fossil is somewhat lower than that of the *Sinokannemeyeria*-fauna here under-consideration. It may represent the lower part of the Ehrmayin formation or a new level somewhat older (Fig. 62, p. 87).

**Table 17. List of fossils found in various localities of Shansi**

5521. *Shansiodon* sp.
Kannemeyeridae indet[1)]
5522. *Sinokannemeyeria pearsoni* Young.
5523. *Shansiodon wuhsiangensis* Yeh
Kannemeyeridae indet
*Sinognathus gracilis* Young
*Shansisuchus shansisuchus* gen. .et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.
*Wangisuchus tzeyii* gen. et sp. nov.
5526. *Shansisuchus shansisuchs* gen. et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.
5532. *Parakannemeyeria* cf. *youngi* Sun
?*Shansisuchus* sp.
5534. Kannemeyeriidae indet.
*Shansisuchus shansisuchus* gen. et sp. nov.
*Fenhosuchus cristatus*. Young hen. et sp. nov.
Labyrinthodonts.
5535. *Shansisuchus shansisuchus* gen. et sp. nov.
*Wangisuchus tzeyii* gen. et sp. nov.
Labyrinthodonts.
5537. *Chasmatosaurus ultimus* sp. nov.
*Shansisuchus heiyuekouensis.*
*Shansiodon wuhsiangensis* Yeh
Kannemeyeriidae indet
5673. *Shansiodon wangi* Yeh.
5674. Kannemeyeriiae indet.
5675. ?*Shansiodon*. sp.
*Shansisuchus shansisuchus* gen. et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.
*Fenhosuchus cristatus* gen. et sp. nov.
56153. cf. *Sinokannemeyeria pearsoni* Young
*Shansisuchus shansisuchus* gen. et sp. nov.
56155. *Parakannemeyeria* sp.
*Shansisuchus shansisuchus* gen. et sp. nov.
56157. *Shansisuchus heiyuekouensis* sp. nov.
*Wangisuchus tzeyii* gen. et sp. nov.
56159. Kannemeyeriidae indet.
*Shansiodon* sp.
*Shansisuchus shansisuchus* gen. et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.
*Fenhosuchus cristatus* gen. et sp. nov.
56172. *Parakannemeyeria* sp.
*Shansisuchus shansisuchus* gen. et sp. nov.
56173. *Parakannemeyeria youngi* Sun.
*Shansisuchus shansisuchus* gen. et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.
*Fenhosuchus cristatus* gen. et sp. nov.
*Wangisuchus tzeyii* gen. et sp. nov.
Labyrinthodonts.
56175. cf. *Sinokannemeyeria pearsoni* Young
*Shansiodon* sp.
*Neoprokolophon asiaticus* Young
Nwc, E. *Shansisuchus shansisuchus* gen. et sp. nov.
Probably associated with kannemeyerids.
Nwc, E. D. *Parakannemeyeria dolichodephala* Sun
*Parakannemeyeria ningwuensis* Sun
*Parakannemeyeria* indet.
*Shansisuchus shansisuchus* gen. et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.
(Kuanwukou, Chinglo, V. 2507)
Kannemeyeridae indet
*Shansisuchus shansisuchus* gen. et sp. nov.
60116. Parakannemeyeria indet.
*Shansisuchus shansisuchus* gen. et sp. nov.
*Shansisuchus heiyuekouensis* sp. nov.

The fossil contents of various important localities shown above indicate that the kannemeyerian remains and most members of pseudosuchian occur together. The presence of *Sinognathus gracilis* in 5523 is especially interesting as it is the leading characteristic fossil comparable with the lower *Cynognathus*-zone of South Africa.

The *Neoplocolophon asiaticus* from 56175 gives itself no definite clue for age determination. Structurally it is more advanced than the true *Procolophon* and was found in association with *Sinokannemeyeria peassoni* according to the determination of Sun. The latter is supposed to be somewhat older than the kannemeyerids.

Almost all the two species of *Shansiodon* were found together with both Kannemeyerids and the pseudosuchians.

1) For the determination of Kannemeyerids. According to the Table given by Sun, 1963, p. 49.

In our previous preliminary study of the fauna (Young, 1957 and Young and others 1959, 1959A) and recently adopted by Sun (1963) the fossiliferous beds of the Wuhsiang area are divided into five "bone beds". It is of course true that the lower bone beds are older than the younger ones. The genus *Sinokannemeyeria* may be somewhat primitiver but the association with *Shansisuchus* reduces very much the weight. As far as we can drawn from the above census of the whole fauna we can not find any reliable data for a sharp separation paleontologically.

The Ehrmayin series of Shansi represents thus clearly a faunistical unit characterized by number of Kannemeyerids, rich forms of pseudosuchians and a few characteristic forms like *Sinognathus, Neoprocolophon* and a special kind of *Chasmatosaurus.*

This fauna is widely distributed. Its extension to Ningwu and Shinghsien suggest that the bone beds of the Ehrmayin Formation is rather constant. The remarkable preservation of both species of *Shansisuchus* of the locality 60116 are even better than in Wuhsiang area.

The fossiliferous beds of the late Permian and Triassic of China thus may be summarized in the following Table:—

**Table 18. Succession of the so far known horizon of the vertebrate remains of the late Permian and Triassic of China**

| | |
|---|---|
| Upper most Trias (Rhaetic) | Lower Lufeng Series of Lufeng, Yunnan. |
| Upper part of Upper Trias. | Missing |
| Lower part of Middle Trias. and Upper part of Lower Trias. | Ehrmayin Formation |
| Same as above or may be slightly older | Lincheyue Bone Beds. |
| Lower Trias. (*Lystrosaurus*–Zone) | *Lystrosaurus* and *Chasmatosaurus* of Jimusar, Sinkiang. |
| Lower Trias. or Upper Permian | *Dicynodon sinkiangensis*[1] Beds Jimusar, Sinkiang. |
| Upper Permian | *Shihtienfenia*–Beds of Paote, Shansi. [2] [3] *Urumuchia*–Beds of Urumuchi, Sinkiang. |

## A review of Pseudosuchians in China

In order to get a whole view of the pseudosuchians in China, it is better here to give a review of the so far known forms of this sub-order besides those described in this paper.

### *Chasmatosaurus yuani* Young

Young, C. C., 1936.

**Horizon and locality.** *Lystrosaurus* Beds from Jimusar, Sinkiang. Field number 900002.

**Material.** Anterior part of skull with associated lower jaws and a few vertebrae and limb bones.

**Remarks.** It is a typical *Chamatosaurus* characterized by the downward bending of the muzzle. The teeth are also characteristic, bending conspicuosly backwards. The vertebrae still bear intercentrum. The distal part of a humerus illustrated in Figure 13,b. as Os. incertae sedis may be actually the humerus of this form. The bone illustrated in Figure 11,c as right astragalus is a calcaneum.

In the collection of Yuan we have found recently some additional remains of *Chasmatosaurus* from the

1) Recently re-determined by Sun as a form related to kannemeyerids and regarded as a new genus *Jimusaria Sinkiangensis.* The stratigraphical position of it does not seem to support this idea. Anatomically the unusual pointed muzzle and the enormous size of temporal opening etc. favour not at all the kannemeyerids.

2) Recently two partly articulated skeletons of a cotylosaurian have been discovered from the so far barren beds of the Shihtienfen Formation by Sun and others. The mentioned materials have been published since the manuscript was sent to prees. See Young, C. C., 1963: On a new Pareiasaur from the Upper Perminn of Shansi, China. Vert. Pal. 7(3), 195—212.

3) A fish bearing beds have been recorded by a tooth and a scale from the Shihhatze Series of Shansi representing a new vertebrate horizon not included in this Tnble. Both the *Sinokannemeyoia*-bearing fauna of the Ehemayin Formation and the pruiasanrian benring fauna of this Shihtienfen Formation have been recently recorded in Tsiyuen hsian, N. Hounan.

same area but different locality (600068), Talungkou Jimusar Sinkiang. They are clearly typical *Chasmatosaurus yuani*. It seems thus, this form is a rather common animal in association with *Lystrosaurus*[1].

### *Chasmatosaurus ultimus* sp. nov.

Young, C. C., 1958 *Chasmatosaurus yuani*. On the occurrence of *Chasmatosaurus* from Wuhsiang, Shansi.

**Material.** Skull fragment with lower jaws. V.2301.

**Horizon and locality.** Lower part of Middle Trias or upper part of Lower Trias from Shihpienkou, Lotzeyue, Wuhsiang (5537), associated with certainly *Shansiodon wuhsiangensis* Yeh and doubtfully *Sinokannemeyeria* sp.

**Remarks.** The previous determination has to be revised. In anatomical feature this form is typically *Chasmatosaurus* by its shape of the upper and lower jaws and teeth. But our form is much smaller than that of *Chasmatosaurus yuani* and the teeth are much more backwards bending with longer base of the crown. It should be regarded as a new species for which the name *Chasmatosaurus ultimus* sp. nov. is proposed. The specific name suggests that this new form is not a member of an older horizon before the *Sinokannemeyeria*-bearing Beds but derive from the same general level. During the course of the description the *Shansiodon wuhsiangensis* was erroneously considered as *Lystrosaurus*. As proved by later study there is no such form present in Shansi and the entire fauna of Ehrmayin should be regarded as a whole faunastical unit. This new species is therefore the representative of the last survival not only of this genus but also of proterosuchid as a whole.

The measurement given for the length of the anteorbital opening in the description of the previous paper should read 47.5 instead of 17.5.

### *Platyognathus hsui* Young

Young, C. C., 1944

**Material.** Anterior part of a pair of lower jaws with broken and sockets of teeth.

**Horizon and locality.** Dark Red Beds of the lower Lufeng Series, Upper Triassic age, from Huangchiatien Lufeng, Yunnan.

**Remarks.** Nothing can be added to the previous description. The co-ossification of the two lower jaws and the differentiated post canine-tooth indicate a special development. It is probably one of the end forms of a small pseudosuchian. Huene (1956) groups it to the family Euparkeridae. The present study, especially the *Wangisuchus* does not give any positive proof of it. It is certainly an aberrant form quite different from all the known pseudosuchians.

### *Microchampsa scutata* Young

Young, C. C., 1951.

**Material.** 11 vertebrae and three rows of scutes.

**Horizon and locality.** Upper Triassic of the lower Lufeng Series from Huangchiatien. Lufeng, Yunnan.

**Remarks.** There is nothing to add to the poorly known form. In my previous description it was grouped under Protosuchia, but the possibility of being a pseudosuchian is equally probable. Huene (1956) puts it under the family Spheneosuchidae but does not exclude of being a crocodile. His latest opinion (1962) did not go much further, we tentatively include it in the following list of pseudosuchians of China.

1) The additional remains have been studied and published since this manuscript was sent to press. See Young, C. C., 1963: Additional remains of *Chasmatosaurus yuani* Young from Sinkiang, China. Vert. Pal. 7(3), 215—222.

### ***Pachysuchus imperfectus*** **Young**

Young, C. C., 1951 p. 25.

**Material.** A skull fragment.

**Horizon and locality.** Same as above.

**Remarks.** This is the only parasuchian found in China, so close systematically to the pseudosuchians. But it is so poorly known that nothing can be added at present. It indicates only that this sub-order is known in China. It is rather curious not to find any trace of the presence of this sub-order in the so rich fossiliferous Beds of Shansi.

Now, we are in position to give a full list of the fossils of the Order Thecodontia in China.

**Table 19. List of thecodonts known in China**

| Age | Systematic position | Locality | Name of fossils |
|---|---|---|---|
| Upper most Trias.[1] | Parasuchia<br>?Pseudosuchia<br>Pseudosuchia | Yunnan<br>Yunnan<br>Yunnan | *Pachysuchus imperfectus*<br>*Microchampsa scutata*<br>*Platygnathus hsui* |
| Lower part of Middle Trias. or upper part of Lower Trias. | Pseudosuchia<br>Pseudosuchia<br>Pseudosuchia<br>Pseudosuchia<br>Pseudosuchia | Shansi<br>Shansi<br>Shansi<br>Shansi<br>Shansi | *Shansisuchus shansisuchus*<br>*Shansi. heiyuekouensis*<br>*Fenhosuchus cristatus*<br>*Wangisuchus tzeyii*<br>*Chasmatosaurus ultimus* |
| Lower Trias. (*Lystrosaurus*-Zone) | Pseudosuchia | Sinkiang | *Chasmatosaurus yuani* |

1) The age of this formation is most probably Rhaetic, on the whole, but the upper part of it may extend to Lias but by no means higher. The here named three thecodonts occur in Huangchiatien, much higher than lower fossiliferous level with *Bienotherian* and may be somewhat younger as recently pointed out by Patterson and Olson (1961) on .the study of the primitive mammals from the same level.

It is obvious that the finds of pseudosuchians in Shansi added greatly our knowledge of this group and filled the wide gap between the Upper Trias. and Lower Trias. They are also much better and richly represented.

## Comparison and correlations between the *Sinokannemeyeria*-fauna of China and other parts of the world

**Table 20. *Sinokannemeyeria* Faunas of Shansi comparable with those Karroo, S. Africa**

| Fossils in China | Similar forms in S. Africa |
|---|---|
| Labyrinthodonts | Capitosaurids, close comparison not sure. |
| *Neoprocolophon asiaticus* | —— |
| *Shansiodon wangi* | *Kannemeyeria simocephalus* |
| *Shansiodon wuhsiangensis* | |
| *Sinokannemeyeria pearsoni* | |
| *Sinokannemeyeria yingchiaoensis* | |
| *Parakannemeyeria youngi* | |
| *Parak. ningwuensis* | |
| *Sinognathus gracilis* | *Cynognathus* and its allied forms |
| *Chasmatosaurus ultimus* | |
| *Shansisuchus shansisuchus* | *Erythrosuchus africanus* |
| *Shans. heiyuekouensis* | ? |
| *Fenhosuchus cristatus* | —— |
| *Wangisuchus tzeyii* | *Euparkeria capensis* |

## A. Compared with the Karroo Formation of South Africa

During our course of the study of the reptiles of Shansi nearly all the forms are comparable with the similar ones in the well known Karroo Formation. Namely (see Table 20):

According to the study of Sun on the Kannemeterids from Shansi the closed form to the both genera is *Kannemeyeria smocephalus*. The *Sinogathus asiaticus* is very close to the similar form of the *Cynognathus*-Zone of S. Africa. The present research on the pseudosuchia especially the large *Shansisuchus shansisuchus* shows that they are closely related to *Erythrosuchus africanus,* even the latter with only an additional preorbital opening. As I have suggested before the number of the preorbital opening of *Erythrosuchus* can be doubted. If so, their relationship must be still closer. The relationship between *Wangisuchus* and *Euparkeria* is not so clear, yet very suggestive. Less clear is the presence of the genera *Neoprocolophon* and *Chasmatosaurus*. According to the section both were found from the middle part of the formation, the third Bone Beds. The only explanation is that their stratigraphical position extends somewhat higher. It is one of the reasons why we regard the age of the formation may include part of the upper part of the Lower Triassic as indicated by the presence of the survival of the archaic forms.

On the whole it is sufficiently clear to conclude that the *Sinokannemeyeria*-fauna of Shansi is an equivalent of the *Cynognathus* Zone of the Beaufort Series of South Africa.

## B. Compared with the Pseudosuchians in U.S.S.R.

In Russland the pseudosuchians are rather well represented. Tatarinov (1960) has made a revision of the whole group. Aside from the stratigraphically older form *Archosaurus rossicus* from Zone IV all the others were derived from the Zone V—VII. The revision of Tatarinov, the original determination and its possible relation with our forms may be given below:

**Table 21. Pseudosuchians in U.S.S.R. with revisions of Tatarinov**

| Original determination | Revision of Tat. | Zones | Notes with Chinese forms |
|---|---|---|---|
| *Chasmatosuchus* rossicus Huene | | V | |
| *Chasmatosuchus* sp. | | V | |
| *Garjainia prima* | *Erythrosuchus primus* Orchev | V | |
| ?*Chasmatosuchus Vjushkovi* Orchev. | | V | |
| *Dongusia colorata* | *Erythrosuchus coloratus* | VI(1) | |
| *Vjushkovia triplicostatus* Huene | *Erythrosuchus triplicostatus* | VI—VII | Comparable with *Shansisuchus heiyuekouensis* |

There is little to say about the genus *Chasmatosuchus* from Zone V. It belongs to the family Proterosuchidae and most probably comparable with the *Lystrosaurus*-Zone of South Africa.

For the other pseudosuchians the question arises seriously. I am not intended to discuss the question concerning Tatarinov's revision in referring the Russian forms of late pseudosuchians to the South African genus *Erythrosuchs* and to group them all in this single genus. It would be too good to be true. As far as one can judged from the left sided picture of *Garjainia,* I doubt very much that it can be either a *Erythrosuchus* or *Shansisuchus* by the shape of various openings, especially the highly and obliquely oriented single anteorbital opening. The downward bending of muzzle does not fit also with any Erythrosuchids and *Shansisuchus*. The quadrate looks also more backwards slanting. It is also much smaller than the species of South Africa.

*Chasmatosuchus vjushkovi* is imperfectly known for saying something definite, even Tatarinov considers it as probably a young individual of his "*Erythrosuchus*".

Both *Dongusia colorata* (According to both Olson and Tatarinov, it is derived from Zone VI not from the *Lystrosaurus*-Zone as given by v. Huene) and *Vjushkovia triplicostata* are about the same size and rather similar to our *Shansisuchus heiyuekouensis* in size. Structurally we are not sure about the number of the preorbital openings in all of these forms, so that the closer relationship is difficult to draw. But so far we can say they are certainly not the true *Erythrosuchus*. In all the known Erythrosuchidae besides the specimens described by Huene, there is no one with the parietal opening developed. Both are much smaller than the true *Erythrosuchus* of South Africa and differ from it by many minor features. *Donguxia colorata* is only represented by one single vertebra but rather characteristic and not surely found in our collection. The same is for the three branched head of the ribs so well known in the vertebrae of *Vjushkovia triplicostata*.

All in all, it is very clear to conclude that it is impossibly to combine all the late pseudosuchians in a single genus *Erythrosuchus*, as done by Tatarinov. Recent works on the classification of this group (Kuhn, 1961; Huene, 1962) support our idea definitely.

Inspite of the rather confusion of the determination and revision of those forms, it is nevertheless, very clear that our fauna of Shansi represent about the same age as the Zone VI and part of Zone VII of the USSR. The level of *Garjainia* may be somewhat older, perhaps the top of zone V.

Provisionally we must admit that nearly all the Chinese forms described in the present paper strictly speaking not found in Russland instead of the closer geographical distance. The absence of cynodonts, procolophons and chasmatosaurs in Russland and poor representation of the Labyrithodonts in the Chinese fauna make the correlation rather unsatisfactory.

### C. Compared with other parts of the world

There are no other place in the world which can be compared closely with our fauna besides the two mentioned above. Yet, it is interesting to point out that two faunas may be mentioned in the other side of the globe.

One is the upper Moenkopi Formation of Northern Arizona in N. America with the interesting *Arizonasaurus babbitti* Welles (1947). I am particularly impressed by the shape of the maxilla inner side convex, outer side flat with the much posteriorly situated upper process and the zigzaged dentition border which are almost the same as those of our *Shansisuchus shansisuchus*. I shall not wonder this genus of America may have some close relationship with our form, at least the same family and the upper Moenkopi Formation may be synchronous in age. It must be also noted that the Labyrinthodonts in association with *Shansisuchus* to be described later look quite close also to those of Moenkopi, at least the vertebrae[1].

Huene puts the American genus under the family Stagonolepidae (1956) which is evidently untrue (1956). Later in 1962, he considers this genus as family indeterminable. I would think it is probably a member somewhat related to the Chinese form.

The other one is the Ischigualastian fauna of Argentina in South America. I am not in position to give a full accounts of the latest discovery but the interesting finds of *Proterochampsa barrionuevoi* and *Saurosuchus galilei* from the so-called Mesotriassic of this place by Reig (1958) leads one to conclude that the fauna is closely comparable with our fauna. The large *Saurosuchus* (skull 650 mm long) is considered by Reig as belonging to Ornithosuchoidea and is much larger than our *Wangisuchus* but in some way comparable by the shape of the maxilla and the teeth. Furthermore a large dicynodont is announced by Cox

1) See foot note, p. 110.

(1962) also from this Formation. The skull is 550 mm long and 460 mm broad. It is named as *Ischigua-lastia jenseni* gen. et sp. nov. without illustration. It would be not surprise that this new form may bear kannemeyeridian affinities. According to Romer the age of Ischigualasto fauna is Middle Triassic in age, comparable with the Santa Maria Beds of Brasil and Manda Beds of Tanganyika (1962). Since our fauna is somewhat older in age and the *Ischigualastia* fauna is still imperfectly known, a precise condition appears to be premature. The data of the other pseudosuchian *Argentinosuchus* Casamiquela (1960) from the Upper Triassic listed in Huene's paper, 1962, is not available.

The correlation of the so far discussed formations may be summarized as follows:

**Table 22. Correlation of Pseudosuchian fauna of Shansi with the other parts of the world**

| | China | S. Africa | U.S.S.R. | N. America | S. America |
|---|---|---|---|---|---|
| Upper Trias | | | | | |
| Middle Trias | | *Cynognathus*-Zone | Zone VI and part of VII | | Ischigualasto |
| Lower Trias | *Sinokannemeyria* Fauna | | | Moenkopi F. | |

## Classification and radiation

The classification of the order Thecodontia is repeatedly given by various authors in recent years [Huene, 1956; Piveteau (by Hoffstetter for this group); and Romer, 1956 and Kuhn, 1961]. These different arrangements of the sub-orders and families differ basically very little.

In a recent paper of Huene (1962) he has made, however, a rather radical change in the classification of the sub-order Pseudosuchia. We agree fundamentally with his conclusion in considering the relationship between Pseudosuchia and later archosaurians, but not with part of the classification. He grouped the so far known 48 genera of Pseudosuchia into five ordinary families (not including *Saurosuchus* of Reig) with the belongings of ten genera indetermined.

The family Proterosuchidae include *Archosaurus, Proterosuchus Chasmatosaurus, Chasmatosuchus* and *Elaphrosuchus,* basically the same as he has done before.

The family Sphenosuchidae includes 18 genera with forms like *Sphenosuchus, Ruuisuchus, Prestosuchus, Eryptosuchus, Elackistosuchus, Vjushkovia, Euparkeria, Stagonosuchus,* and so on. By the size, structure and geological age of the different genera, it is very hard to believe that they are grouped in the single family.

The family Erythrosuchidae includes *Erythrosuchus, Dasygnathus* and *Dongusia.* There is no fundamental changes except the abandonment of the name of the super family.

His family Ornithosuchidae includes the genera *Ornithosuchus Hesperosuchus* and *Clarenica* only.

The fifth family Sceleromochidae includes only the genus *Sceleromochlus,* same as his former classification.

The members of his sixth family Actosauridae are basically those of Whaker's classification.

The genera not included in the above six families are *Arizonasuchus, Garjainia, Platygnathus, Microchampsa* etc.

We have little to say about the families 1, 3, 4, 5, and 6, because the basic idea differs not very much from the current classification by various authors. For the second family we think that the Sphenosuchus so close to the Crocodilia should be considered as the representative of a family. The large *Ruuisuchus* and its related forms with the premaxillary teeth well developed and the poorly developed dermal scutes

should be regarded as a well defined family too. The same is for the smaller *Euparkeria* which is very close to the *Ornithosuchus*. Furthermore, it seems more clear to keep the super-families such as to combine Preterosuchidae and Erythrosuchidae under Protherosuchoidae, Euparkeridae and Ornithosuchidae under Ornithosucoidea.

Therefore I would prefer at least at present to use the one of Kuhn, 1961 for the following review, not only because it is one of the latest classifications of pseudosuchia but also because it seems to be more natural. A slight modification has been made for the present purpose.

**Table 23. Classification of Thecodontia (modified from Kuhn)**

| Order | | Thecodontia | | | | | |
|---|---|---|---|---|---|---|---|
| Sub-Order | | Pseudosuchia | | | | | Parasuchia |
| Superfamilies | Proterosuchia | Ornithosuchoi-dea | Chirotherioidea | Elachistosu-choidea | Scleromochloi-dea | Sphenosuchoi-dea | |
| Families | Protersuchidae Erythrosuchidae Shansisuchidae | Euparkeridae Ornithosuchidae Sceleromochli-dae etc. | Aetosauridae (in the sense of Walker Rauisu-chidae etc.) | Elachistosu-chidae | Scleromochloi-dae | Sphenosuchoi-dae Pedetico-sauridae | |

In the six super-families (Fig. 63, p. 92), the first three are represented in China possibly also the last super-family. The first one includes three families, the family *Erythrosuchidae* may be a synonymous with Shansisuchidae, if the former proved to have two preorbital openings. The genus *Vjushkovia* either as a representative of a family or as a single genus should belong to this super-family. Because it is, neverthe-less, very similar to *Erythrosuchus* as observed by Tatarinov, although it is by no means a synonymous of it. This is the group which Romer considers as a sub-order parallel with the other pseudosuchians.

As far as the premaxilla of *Shansisuchus shansisuchus* is concerned (except the rather high position of the posterior process of the premaxilla for separating the nasal and the first preorbital opening), this very bone is not so specialized [In fact the premaxilla of the genus *Elaphrosuchus* foreshadows already the high position of this process (Broom, 1946, p. 345, Fig. 2,A)]. Therefore, it can not be so close to Huene's second family but much to Proterosuchids.

The ornithosuchoidea includes many families, large to small forms, but all with elongated skull and carnivorous teeth. They are more slenderly constructed than the preceding super-family but seem to have more closer relationship as compared with the others.

There are many similarities of *Wangisuchus* with the family Euparkeridae represented by *Euparkeria*. Apparently the genus *Saurosuchus* Reig is a member of Ornithosuchidae. All are under the same super-family.

Chirotheriodea is also a complex group. Part of them under the family Aetosauridae in the sense of Walker. The skull and the teeth are quite different in structure as compared with other two superfamilies. The skull is more pointed, no or poorly developed teeth in premaxilla and anterior part of the mandible and the teeth are peg-shaped and primitive.

The other genera may be grouped under the family Rauisuchidae in the original sense of Huene, with the exception, of course, of those genera like *Typothorax* etc. belonging to the above family. It includes mainly *Rauisuchus, Prestosuchus* and *Stagonesuchus* etc. The teeth are not reduced in this family. Further-more, the vertebrae of the anterior dorsal are keeled and the dermal scutes not cover the whole body. The *Fenhosuchus* described in this paper is apparently a member of this family.

There is little to say about the small *Elachistosuchus*, the only representative of this super-family. The super-family Sphenosuchoidea is also only represented by a single genus.

There is no representative of both found in our collection. Since both are very peculiar in structure and the latter may be closely related to crocodiles, we think it is better to keep them separately as super-families as done by Kuhn. The family Scleromochlidea represented by a single genus is considered by Kuhn as member of the super-family Ornithosuchoidea. Since it is so peculiar in structure and may be related with the Pterosaurians and its rank may be raised to the super-family order Scleromochloidea (new name) with the other super-families. It is not represented in our collection.

In so doing we have six super-families of Pseudosuchia as shown in Table 23. It is quite similar to the classification of Huene, 1962 only with the rank higher Preterosuchidae and Erythrosuchidae combined into one super-family and Hisphenosuchidae splits in to part, one as the super-family Sphenosuchidae, and the other as Rauisurchidae, belonging to super-family Chirotherioidea.

With this classification of the order Thecodontia in mind we may say something concerning the evolution of this order.

It is generally accepted that all the latter archosaurian orders and families including the birds are derived from the order Thecodontia. In many cases it is pretty sure to assume a rather satisfactory relationship between one of the thecodontians and one of latter forms. The well known *Sphenosuchus,* for instance, is regarded as the forerunners of the crocodiles. It is also suggested that the *Scleromochlus* may have something to do with the pterosaurs and birds, but still less sure is the ancestors of various groups of the dinosaurs.

Take a glance on the stratigraphical distribution of the two sub-orders of Thecodonta and the other orders of the archosauria shown in Figure 63, it is clear that the ancestors of the dinosaurs should be searched in the so far known three super-families, namely Proterosuchoidea, Ornithosuchoidea and Chirotherioidea, all with representatives in the fauna of Shansi.

In the upper Triassic, both saurischians and ornithischians begun to appear so that all the forms of the super-families Ornithosuchoidea and Chirotherioidea in the same period can not be regarded as the direct ancestrals of any of the orders of Dinosauria. It is evident that the ancestral types of them must be searched in the Middle or even Early Triassic. Unfortunately the Middle and the Lower Triassic pseudosuchians are rather rare. It is, therefore, any clue, which may indicate such relationship, is particularly wellcome.

As noted in previous pages the skull of *Shansisuchus shansisuchus* with its additional preorbital opening, carnivorous teeth are very similar to the skull of late carnivorous dinosaurs as the *Teratosaurus* of the Upper Triassic and many of later ages. The significance of the additional number of the preorbital openings should not be under estimated as it is certainly in close connection with the structure of the head and way of living.

The postcranial skeleton is more primitive and typically quadrupedal, so that it is far from that of carnivorous dinosaurs. But it must be noted that the anterior limb of the *Shansisuchus shansisuchus* begins to shorten (Humerus and radius: femur and tibia 78—85 and fore limb: hind limb 71—79). In addition, there are some specialized features such as the less number and extreme shortness of the neck vertebrae and the primitive nature of the pectoral and pelvic girdles prevent any closer consideration of further comparison with the carnivorous dinosaurs. It is certainly not the direct ancestor of the latter. On the other hand, it seems very probably that the ancestral of carnosaurians has to search in the super-family Proterosuchoidea and an unknown form with the skull somewhat like *Shansisuchus* but more advanced limbs are to be expected. Our new form is certainly close to such hypothetical one.

As noted above, *Ornithosuchus* of the Upper Triassic lived together with many true dinosaurs, so that it has nothing to do for a direct relationship. The genus *Euparkeria* of Middle Triassic looks better. In

China *Wangisuchus* is believed to be a member under the super-family Ornithochoidea and comparable with *Euparkeria*. The Chinese species is larger and the dermal scutes tend to reduce as in *Euparkeria*. The limb bones are thinly walled and in general slender. It is therefore, not improbable that the Coelurosaurians may be derived from the family Euparkeridae. In turn it is also not improbable this family represents a side line of some proterosuchoids, because by the structure of the teeth both are certainly more close each other than with other members of the sub-order. This will help to explain why some of the late celurosaurians bear more than one preorbital openings.

There are no great difficult to derive the sauropods from the two super families of the Pseudosuchia. The structure of the pelvic girdle is closely comparable with that of both families, especially the first by slightly lengthening of pubes and ischium and by the loss perforation of the acetabulum. The quadrupedal gait is even the same as for instance in *Shansisuchus shansisuchus*. It is therefore not impossible that the quadrupedal sauropodians may be derived directly from much older forms like Proterosuchids. The quadrupedal gait is a primary character while the bipedalism of various forms is secondary in nature. The lengthening of the neck is of course a specialization acquired later. Nevertheless the direct ancestor seems little to do with known forms at present, although it may be quite close to one or the other of the two families of the pseudosuchians, certainly not the Chirotherioidea and other families.

The prosauropodians of the Upper Triassic is long considered as the ancestral group of the Sauropoda. But if the above statement is true prosauropodians represent only a side line and nothing to do with the late sauropodians. Their ancestral has to be searched likewise in the middle or even basal Triassic.

The third super-family left is chirotheriodea the first family Aetosauridae with Aetosaurus and other related genera by Walker are all heavily covered by dermal scutes. Most of the known forms are upper Triassic in age and highly specialized. Only a few forms of the second family Rauisuchidae like *Rarisuchus* are Middle Triassic with the dermal scutes poorly developed and is also not a generalized forms. In China we have *Fenhosuchus* which shows some relationship with is genus. The neck vertebrae are longer, the dorsal vertebrae highly crested on the lateral side. The skeletons and the dermal scutes are much specialized so that it has little to do with the direct ancestral relation of the later dinosaurs. Nevertheless, the edentatous feature of the anterior part of the upper and lower teeth and the leaf-like feature of the first group Äetosauidae, show some relationship with the primitive ornithischians as recently suggested by Huene (1962). The oldest known ornithischians are very rare in Lower Jurassic and Upper Triassic. The newly discovered *Heterodontosaurus* changed however the situation considerably (Crompton & Charig, 1962). It is already true ornithisuschian and the *Stagonelepis* and other forms, are also Upper Triassic, therefore the ancestral type of ornithischians has to be searched evidently in the Middle Triassic or older. Most probably it may have some relationship with the Aetosauridae of the chirotherians or still unknown form. The other family Rauisuchidae, of which our *Fenhosuchus* is closely related, seems to have no real survivor, its Possible relationship with parasuchinas has already suggested before.

We have no representatives of the other three super-families. Their relationships with the later archosauriaus are suggested in Fig. 63. Only the systematic position of the super-family Elachistosuchoider is less clear (p. 92).

In Figure 64, we have indicated graphically most of the interesting representatives of super-families and their possible relationships with later archosaurians in chronological order (not to scale) as supplementary part of Fig. 63. In doing so, it is highly suggestive the relationships of the thecodontia and the latter orders of archosaurians are mostly, if not all, paralleled development and polycenters in nature. Nearly all

the latter orders are independently derived from the order Thecodontia. Of course, there are still many points remain to be clear and the facts are in most cases very scant. But the essential lines of evolution of the various groups seem rather clear (p. 94).

The discovery of rich pseudosuchians in China added very little concerning this purpose but they certainly give some clues very useful for future research.

## Pathological and ecological comments

The abundant occurrence of pathological bones of *Fenhosuchus* has been already noticed before. The asymmetrical development of the vertebrae and the thickening of the articulated ends of the limb bones are very conspicuous. The reason for this is, however, not quite clear. Since the percentage of the pathological bones is very high, the abnormal development may indicate that the animal is not quite fit with the environment and is destined to the end of their fate. It is also possible that many of the pathological bones are the result of recovery of injury. Despite the heavy protection of the dermal scutes the animal is, nevertheless, the object of aggression of the huge carnivorous *Shansisuchus shansisuchus,* and other smaller carnivorous beast like *Sinognathus* living in the same time. Both cases may hold true. In any way, it was hard time for *Fenhosuchus* to live. In case that the protectless Kannemeyerids at the same time have practically no pathological bones observed, we prefer to think that the first reason may be more effective.

The positive pathological bones are few in other species. However, we are not sure that the bones described and figured in Figure 9,A; of *Shansisuchus shansisuchus,* Fig. 38; Fig. 39,A; 41,D and E; of *Shansisuchus heiyuekouensis* and Fig. 46,D of *Fenhosuchus* are really pathological origin or bones indicating some other forms present in the fauna.

Both the *Shansisuchus shansisuchus* and, *Fenhosuchus cristatus* the young aged individuals including juvenile and infant ones are rather common. According to Sun (1963), there are also young specimens present in 56173 of the species *Parakannemeyeria youngi.* This fact shows that those bones were deposited only from a short distance where they met the fate of death in the mass. The partly articulated skull and limb bones in the sediments support this assumption.

**Table 24. Biological characters of the fauna**

| Locality | Fossils | Mode of life | Place of living |
|---|---|---|---|
| 5523 | *Shansiodon wuhsiangensis* | Herbivorous | low land and swamps |
| | Kannemeyeridae indet | Herbivorous | low land and swamps |
| | *Shansisuchus shansisuchus* | Predacious | low land and swamps |
| | *Shansisuchus heiyuekouensis* | Predacious | low land and swamps |
| | Labyrithodonts indet. | Herbivorous | low land and swamps |
| | *Wangisuchus tzeii* | Predacious | Plain or high land |
| | *Sinognathus gracilis* | Predacious | Plain or high land |
| 56173 | *Parakannemeyria youngi* | Herbivorous | Low land and swamps |
| | *Shansisuchus shansisuchus* | Predacious | Low land and swamps |
| | *Shansisuchus heiyuekouensis* | Predacious | Low land and swamps |
| | *Fenhosuchus cristatus* | ?Predacious | Low land and swamps |
| | *Wangisuchus tzeii* | Predacious | Plain or high land |
| | Dabyrinthodonts indet. | Herbivorous | Low land and swamps |
| Nwe, E. D. | *Parakannemeyeria dolichocephala* | Herbivorous | low land and swamps |
| | *Parakannemeyeria ningwuensis* | Herbivorous | low land and swamps |
| | Parakannemeyeria indet. | Herbivorous | low land and swamps |
| | *Shansisuchus shansisuchus* | Predacious | low land and swamps |
| | *Shansisuchus heiyuekouensis* | Predacious | low land and swamps |

Although we have made extensive field work in those fossiliferous beds, and yet the fauna seems rather poor in forms. Both the Kannemeyeridae and most of the pseudosuchians are rich in individuals. As shown in Table 17 most of the localities contain forms less than five in number. Only three localities we have five or more and may be considered as the representatives for analyzing the composition and population of the fauna (see Table 24).

From the above list it is clear that most of the forms in the fauna belong to animals of herbivorous type and living in the swamps marshes and lagoons. By the teeth of *Shansisuchus shansisuchus* the animal is certainly predacious. The same is probably also the other small species. Although no sure presence of the teeth is known. But the plump and massiveness of the postcranial skeleton seems to indicate that they are not active animals and probably living in the same environment as the Kannemeyerids and Labyrinthodonts. There are surely enough hiding places for them to make effective attack in preying upon Kannemeyerids and other animals and to escape in being noticed by their enemies, if there are any.

Both the smaller *Wangisuchus* and *Sinognathus* are predacious but more active and not living together with kannemeyerids and labyrinthodonts. They live in more high lands. This is the reason why they are so few in the collection. It can not be simply explained by the negligence of collection, because in locality 56173 nearly all the fossil of this site have been moved away and yet very few *Wangisuchus* have been found and no other small forms. They are indeed strangers in most of the localities as compared with the other numbers of the fauna.

The biological condition of *Fenhosuchus* is not so clear. No sure teeth of this form have been observed if the premaxillae and the lower jaws are correctly referred to this form. The teeth seem differ only slightly form *Shansisuchus shansisuchus* at least by the distinct compression of the alveoles. The animal is heavily protected by dermal scutes so its environment may be slightly different from that of others. Presumably it is similar in general biological condition as that of other Aetosauridae and Rauisuchidae.

## The origin of Pseudosuchia

Both Pseudosuchia and Parasuchia form the Order Thecodontias commonly accepted. It is also the current opinion that the latter was derived from some forms of Eosuchia such as *Youngina, Youngoides* from South Africa. This is however very hypothetical because there is huge gap between both structurally and chronologically. The first primitive pseudosuchian *Proterosuchus* is imperfectly known and both *Erythrosuchus* and *Chasmatosaurus* are already too specialized for being the real ancestral forms. Much has to be expected concerning the intermediate types in the upper Permian and lower Triassic strata. For present we are satisfied in regarding the early eosuchians as the origin of Thecodontia. According to Camp (1945) and others, the other known forms as *Prolacerta* and *Tangasaurus* are more related to Lepidosauria.

*Santaisaurus yuani* Koh is now regarded as member of Nyctiphruretidae of Procolophonia and nothing to do with Archosauria as a whole (Huene, 1956, p. 696).

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## P. S.

Since this paper has sent to press, Krebs (1963) has published an interesting note on the foot bones of a nearly complete skeleton of a large pseudosuchian from the anisic stage of the alpine Triassic of Switzerland. Both the astragalus and calcaneum illustrated seem to differ in details from any of those of ours, although they may comparable with those of *Fenhosuchus* both in size and in structure. It is important to observe that similar form of pseudosuchians is recorded from European alpine Triassic comparable with the *Cynagnathus*-Beds of S. Africa and other parts of the world. Unfortunately, it can not be fully used in my present study.

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1) 所有在插图和图版中的标本，如非另作声明，均来自 56173 地点，所有标本均保存于古脊椎动物与古人类研究所标本室。

1) All the specimens illustrated in the text-figures and plates are from the locality 56173 (Hsishihwa, Lotzeyue, Wuhsiang Shansi). Unless otherwise noticed, all are kept in the Museum of IVPP.

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